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X-RAY THERAPY IN NON-MALIGNANT SKIN LESIONS[1]

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THAT the X-ray is the most valuable single agency used in dermatological therapeutics, is an oft-stated axiom and one that becomes more evident with improved apparatus, technic, diagnostic ability, and knowledge of the biological action of roentgen rays. That workers of twenty or more years' experience have affection but no yearning for their earlier technic is not surprising. Any therapeutic agent to be the one of choice in a given condition must combine safety, accuracy, and efficiency. One often discards an effective therapeutic procedure because of technical difficulties or possible bad end-results. That roentgen therapy has survived the "experimental stage" is a tribute to our pioneers. But with improvement in apparatus, the development of direct and indirect methods of measurement using the Sabouraud Noire pastille, the Holzknecht, Hampson, Corbett and Kienböck units, MacKee's arithmetical computation, etc., we still lack a universal understandable description of technic—how often in presumably scientific communications do we read that the author gave so many minutes or milliamperes of X-ray. With numbers of such glaring examples easily recalled, one may perhaps be excused for a more or less complete description of the technic used.

[1]Read before the Radiological Society of North America, at the Thirteenth Annual Meeting, at New Orleans, Nov. 28–Dec. 2, 1927.

AUTHOR'S TECHNIC (AFTER MACKEE)

Interrupterless transformers capable of supplying peak voltage up to 150 K.V., and with mechanical rectification, are used. Medium focus Coolidge tubes obtain primary current from step-down transformers controlled by a sensitive choke coil. Pre-reading voltmeters and milliamperemeters are mounted on the control board. Voltmeters are calibrated by sphere gaps mounted at tube, using fixed amperage and 100 K.V. for unfiltered and 130 for filtered applications, the filter used being 3 mm. of aluminum. The distance used in unfiltered treatment is 8 inches from the anode; with filters, 10 inches. Milliamperage of 2 or 4 in unfiltered and 5 in filtered applications is utilized. With these factors a faint but definite erythema is produced on the forearm by exposing successively 1 inch square areas to increasing amounts of ray. This amount is further checked (unfiltered) in cases of tinea capitis by the production of temporary depilation without erythema. Having thus standardized the apparatus, variations may be mathematically obtained in accordance with the following rules:

1. Quantity varies with the square of the voltage.
2. Quantity varies directly with the milliamperage.
3. Quantity varies directly with the time.

4. Quantity varies inversely with the square of the distance.

Most skin diseases are treated with unfiltered rays because the pathology is superficially located and because unnecessary penetration and corresponding depth effects are unnecessary, and even, perhaps, injurious. Filtered rays are used for lesions of considerable bulk or those situated beneath the skin and the distance increased to facilitate passage of considerable amounts of radiation to the actual pathology without serious skin reactions or loss of intensity due to dispersion of rays or disproportion between surface and depth dosage. Cases requiring extremely short wave lengths are treated with radium. Most dermatological conditions amenable to roentgen therapy respond to small widely spaced doses such as one-quarter to one-half skin units at intervals of from a week to ten days. In some cases, skin toleration approaching 4 units is necessary, the interval in such cases being a minimum of one month. Erythema is avoided except when the possibility of resulting radiodermatitis is considered justified by the urgency of the individual case.

In the following list of non-malignant dermatoses amenable to X-ray therapy, the numerals ¼, ½, 1, 2, 3, or 4 are appended to designate the fractions or multiples of skin units recommended in the various disorders. Dosage of ¼ unit is ordinarily repeated at weekly intervals, ½ at 10-day intervals and 1 to 4 units not under 1 month or until all reactive phenomena disappear. A question mark indicates personal pessimism as to the value of roentgen rays.

DISEASES AMENABLE TO IRRADIATION[2]

Acanthosis nigricans (¼)
Acne varioliformis (¼)
Acne vulgaris (¼)
Actinomycosis (½)
Angioma, cavernous (½ to 1 filtered)
Angioma, senile (½ to 1)
Angioma, strawberry mark (½ to 1)
Blastomycosis (½)
Bromidrosis (¼)
Callositas (2 to 3)
Carbunculosis (1½)
Cheilitis exfoliativa (¼)
Cheilitis glandularis (¼)
Cornu (3)
Dermatitis exfoliativa (¼)
Dermatitis, infectious eczematoid (¼)
Dermatitis papillaris capillitii (½ to 1)
Dermatitis venenata (¼)
Dermatophytosis (eczematized ringworm) (¼)
Eczema (¼)
Erythema induratum (½ filtered)
Favus of the scalp (1)
Folliculitis decalvans (½ to 1)
Furunculosis (¼)
Granuloma annulare (½)
Granuloma fungoides (¼ to ½)
Granuloma pyogenicum (½ to 1)
Granulosis rubra nasi (¼)
Hodgkin's disease (¼ to 1)
Hydrocystoma (½ to 1)
Hyperidrosis (¼ to 1)
Hypertrichosis (1½ to 2½ ?)
Intertrigo (¼)
Keloid (½ to 2½)
Keratosis senilis (2 to 3)
Keratosis, arsenical (2 to 3)
Keratosis follicularis (½)
Kraurosis vulvæ (½)
Leukoplakia (3 to 4)
Leukemia cutis (¼ to ½)
Lichenification (¼ to ½)
Lichen planus (¼)
Lichen nitidus (¼)
Lichen scrofulosorum (¼)
Lupus vulgaris (½)
Lymphangioma circumscriptum (1)
Lymphangitis, chronic or recurrent streptococcic (¼ to ½)
Lymphogranulomatosis cutis (¼)

[2]For explanation of numerals, see preceding paragraph.

Molluscum contagiosum (½)
Neurodermatitis (¼)
Nevus pilosus (1½ to 2½)
Onychomycosis (¼ to ½)
Paget's disease (4)
Parapsoriasis lichenoides (¼)
Paronychia (¼ to ½)
Pernio (¼)
Pityriasis rosea (¼)
Pompholyx (¼)
Prurigo (¼)
Pruritus (¼)
Psoriasis (¼)
Rhinophyma (¼ to 1½)
Rhinoscleroma (¼ to ½ filtered)
Rosacea (¼)
Sarcoid (½ to 1½)
Sarcoma, Kaposi (½ to 3)
Scrofuloderma (½ to 1 filtered)
Sporotrichosis (½)
Sycosis, lupoid (¼ to ½)
Sycosis vulgaris (¼ to 1)
Synovial lesions of the skin (1 to 2½)
Syringoma (½ to 1 ?)
Tinea barbæ (1)
Tinea tonsurans (½ to 1)
Tuberculide (¼)
Tuberculosis orificialis (½ to 1)
Tuberculosis verrucosa cutis (½ to 1)
Verruca plantaris (2 to 4)
Verruca seborrhoica (1 to 3)
Verruca vulgaris (2 to 3)
Xeroderma pigmentosum (keratosis and epithelioma) (3 to 4)

In hypertrichosis it is impossible to effect destruction of the hair papillæ without causing degenerative changes in other skin structures. The electric needle in skilled hands remains the one safe method. While some apparent cures have been obtained in discoid lupus erythematosus with X-rays, the close resemblance of the histopathology of that lesion to that seen in X-ray burns leads one to question the advisability of its use; this contra-indication is the more borne out by the excellent results recently obtained by the intravenous administration of gold sodium thiosulphate. The use of X-rays in xeroderma is also inadvisable because of the histological resemblance of that condition and X-ray burns, but it is advisable to attack malignancy when it develops on xerodermatous skin, not only with X-rays and radium but with any agent deemed indicated, disregarding for the emergency the general dermatological condition.

It is further to be pointed out that X-ray should not be utilized as a routine measure in the conditions listed—the individual case and condition must necessarily determine the dosage and interval for any given therapeutic agent. It is also to be emphasized that in a comparatively few dermatological conditions X-rays alone, regardless of how skillfully applied, will give the best results. Certainly verrucæ, keratoses, keloids, dermatitis papillaris capillitii, etc., respond satisfactorily to proper applications, but in such conditions as acne, blastomycosis, actinomycosis, eczematoid dermatitis, eczema, lichen planus, sarcoids, tuberculides, etc., other measures are of equal if not greater service and best results are obtained only by attack from several different angles. One may cite the usefulness of diet, exercise, and elimination in acne, the value of iodides in blastomycosis and actinomycosis, the varied requirements of local therapy in various stages of eczematoid dermatitis and eczema, or the frequent benefit obtained from arsenic and mercury plus rest—mental and physical —in lichen planus, etc.

Finally, a prerequisite to good results is the establishment of proper diagnosis. Many a case of persistent and lichenified dermatitis is not cleared up because some simple etiological background is not recognized. Thus, a mild ichthyosis predisposing to dermatitis from minor irritation may block therapeutic approach until recognized and properly cared for. Eczematoid dermatitis could be radiated at length without

effect if its infectious and auto-inoculable nature remained unrecognized and not combated. It is of educational value to irradiate unsuccessfully a persistent dermatitis of the face, neck, and hands and to have it disappear promptly after disposing of a primrose. And so one might elaborate at great length, but to what end?

The X-ray, properly used, is the most valuable of a number of physiotherapeutic agents that have to a considerable extent been responsible for placing the specialty of dermatology to the forefront of medical achievement.

DISCUSSION

DR. R. H. STEVENS (Detroit): I wish to congratulate the Society upon the very fine presentation of this subject and its relationship to roentgenology by Dr. Guy. He has emphasized what I have said before this Society some time previously, that the dermatologist should be a roentgenologist or radiologist and the radiologist who treats dermatology should be a dermatologist. Certainly the diagnosis of these lesions is the important thing; one must understand what he is treating before he begins to treat it. Dr. Guy has given us the dosage that has been used in these cases, which is something that he has obtained from his chief, who has done so much for us in radiologic therapy, and it is the best we have up to the present. The time is now here, I think, when we must express this dosage in definite units, when we must use the ionization method and express our dosage in *R*-units so that it may be repeated any time and any place, regardless of apparatus, etc. I certainly am much pleased with Dr. Guy's paper, and I congratulate him upon its excellent presentation.

TREATMENT OF RECTAL CANCER[1]

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THE rectum is one of the commonest locations of intestinal cancer. Disease in this section of the bowel occupies a unique position, since, although it is deep-seated, it is also accessible to palpation and inspection, conditions which facilitate early diagnosis and treatment.

During the last decade there has been marked improvement in treatment of rectal cancer, due to earlier recognition of the disease and to more advanced clinical methods. While surgical methods have remained practically stationary, the technic of radium has shown so great an improvement that today irradiation must be considered equal, if not superior, to surgery. However, one method must not be considered an adversary of the other, as both are important and essential. In selected cases each is capable of producing the desired results, but in a miscellaneous group the most satisfactory results are obtained by an unbiased and combined application of both radium and surgery.

Prior to outlining treatment, an advantage is always afforded by study of the clinical and pathological aspects of the given case. Frequently, on account of advanced age or some chronic malady, the general condition of the patient does not warrant the most radical form of treatment. Under these circumstances palliative treatment, varying according to the patient's condition, may be preferable.

Rectal tumors vary widely in degree of response to physical agents. The majority respond uniformly to efficient radiation. A small percentage will disappear under the influence of relatively small doses, whereas a few are decidedly radioresistant to any dose. The estimation of radiosensitivity of rectal tumors can be determined to an approximate degree by palpation, inspection, and biopsy. Definite determination of this important factor is made by moderate dosage of external radiation, *i.e.*, 10,000 mc. hours at 10 cm. distance over two portals of entry, or a pelvic X-ray cycle consisting of 240 milliampere minutes, with a spark gap of 14 cm., a filter of ½ mm. copper and 2 mm. of aluminum, and a focal distance of 50 cm., administered over four portals of entry.

HISTOLOGICAL CLASSIFICATION

The variations in degree of activity of this disease have been recognized by many authors. Miles (1) states: "Although there is only one type of carcinoma of the rectum, three clinical varieties may be recognized, differing in physical characteristics and degree of malignancy." Broders (2) groups malignant tumors into four classes, graded according to intensity. Dr. Ewing divides rectal cancer, according to the degree of malignancy and degree of radiosensitivity, into three groups. Although the histological indication of these tumors permits their division into three groups, the degree of malignancy in all cases in each group cannot be accurately forecast. Group 3 runs true to form and is the most malignant, but, at the same time, the most radiosensitive variety. Group 2 contains many inaccuracies as to the degree of malignancy and is more radioresistant than Group 3. Group 1 is the least malignant, containing but few histopathological inaccuracies, and is more radioresistant than Groups 2 or 3. This histological information, when considered in conjunction with the clinical aspects,

[1]From the service of Dr. Douglas Quick, Memorial Hospital, New York. Read before the Radiological Society of North America, at New Orleans, Nov. 30, 1927.

offers a substantial basis for prognosis as to the course of the disease.

CLINICAL CLASSIFICATION

The history, the age of the patient, the location, size, shape, induration, and appearance of the tumor together furnish the basis for the clinical grouping of the degree of malignancy. A study of a large number of cases shows sufficient available data to suggest a clinical classification according to the predominant tendencies with which these tumors grow, infiltrate, and disseminate, as follows: (*a*) rapidly growing and early infiltrating; (*b*) slowly growing and early infiltrating; (*c*) slowly growing and early disseminating; (*d*) uniformly growing and infiltrating, but late disseminating; (*e*) stenosing, slowly growing, slowly infiltrating, and very late disseminating types. The degree of malignancy decreases in the order named. The treatment of the last two groups, which, fortunately, comprise the majority of rectal cancers, is relatively satisfactory; whereas the treatment of the first three groups, unless the recognition is very early, is extremely unsatisfactory.

The primary focus of this disease may occur anywhere in the rectal mucosa; the mid-rectum is a frequent situation and the recto-sigmoidal juncture and the lower rectum are two other common locations. The circumferential position of the tumor is important, because of the adjacent structures. All sites of carcinoma of the rectum are accessible for adequate radium treatment. The lower rectum, however, offers additional facilities, as emanation tubes may be inserted through the lumen of the bowel, perineum, or posterior vaginal wall. Surgical removal of tumors of the recto-sigmoidal juncture often requires an extensive abdominoperineal resection, whereas favorably operable tumors of the two lower locations may be conveniently removed by the perineal route.

Unfortunately, the disease is frequently well advanced before its true nature is determined. The size and fixation of the primary focus, therefore, must be carefully considered in all cases. In the less malignant types, early fixation is often due to inflammation, but the fixation accompanying the more malignant types is due to invasion by the cancer itself. Fixation and involvement of adjacent tissues are matters of far more concern than the size of the mass within the rectal wall. Tumors may be classified according to size and fixation into five groups: (1) tumors limited to the mucous and submucous layers; (2) tumors involving the mucous, submucous, and muscular coats; (3) small, medium, or large tumors infiltrating beyond the muscular coats and attached to adjacent structures; (4) medium or large tumors definitely fixed on a broad base to surrounding structures, but not sufficiently extended to produce severe pain (though there may be a feeling of weight in the pelvis); (5) medium or large tumors, definitely fixed by extensive infiltration, producing constant pain. Involvement of the anal canal always produces a certain amount of pain irrespective of the size of the growth or its infiltration.

PROGNOSIS

Patients with rectal carcinoma may be separated into two main groups: (1) favorable, (2) unfavorable, according to the general condition of the patient, location of the growth, radiosensitivity and degree of malignancy of the tumor, and extension of involvement by the tumor cells. Classification according to these factors appears more appropriate than the surgical division into operable and inoperable groups, since the former includes radiological as well as surgical factors. An inoperable tumor may nevertheless be favorable, provided that it lends itself to eradication by irradiation,

whereas a local tumor mass considered as operable may be unfavorable if the condition of the patient contra-indicates radical procedure. The result expected in the favorable group is complete eradication or "clinical cure" of the disease. The unfavorable group is composed of cases in which the disease cannot be completely eradicated by the procedures outlined, or in which radical procedures are contra-indicated. This large miscellaneous group may be subdivided into: (*a*) patients beyond the aid of any form of treatment; (*b*) advanced cases suitable for moderate palliation; (*c*) patients beyond cure but suitable for extensive palliative treatment.

TREATMENT

A. Surgical: Previous to 1917, surgery was the only available method of treatment. However, radical surgery has proved to be suitable for only a small percentage of patients, as the disease when recognized is too far advanced for extensive operation, or the general condition of the patient forbids it. A comparative review of the literature reveals the fact that about 40 per cent of carcinomas of the rectum are considered inoperable, that of those operated on the immediate mortality is nearly 16 per cent, while 25 to 30 per cent of the patients surviving the operation are alive at the end of three years. Assuming that these figures represent the true status of surgical treatment, then we have only 12 to 15 per cent of the patients alive at the end of three years, after 60 per cent have been subjected to a radical procedure. These results cannot be considered satisfactory. Of course, the ultimate percentage of favorable results of cases operated upon depends upon the selection of patients and the skill of the surgeon.

B. Radiological: A review of the literature of the last ten years reveals the fact that many surgeons have attempted to improve their results by the use of radium and X-ray therapy. In 1920, Janeway (3) described a method of treatment that consists of implanting small glass tubes containing radium emanation into the tumor mass. Good results were reported in a few cases. Continuing the work of Janeway, Quick (4), in 1921, with additional improvements, demonstrated conclusively that radium was valuable in the treatment of this disease. Using a somewhat similar technic, Kelly and Ward (5) reported, in 1922, a few cures, and palliation in many cases. Bowing and Anderson (6), May (7), Jones (8), and many others have asserted the value of radium and X-ray therapy. Many forms of radiation have been described; emanation tubes and external radiation have proven to be of greatest value. Our experience with radiation has been that it is not a cure in all stages of the disease, but that it, nevertheless, occupies a very important position in the routine treatment of rectal cancer. When properly used, radiation gives exceedingly good results, but when improperly employed, the result is negligible or often detrimental.

Treatment of cancer of the rectum at Memorial Hospital at present consists in the use of radium, high voltage X-ray radiation, and surgery. We use radium as the principal factor in treatment for practically all cases. Colostomy and radical surgery are also employed whenever additional advantage can be gained by these procedures. Surface applicators, tubes in tandem fashion, and element needles are no longer used as routine methods. Experience has proven that these forms of application should be superseded by emanation tubes.

For a number of years glass tubes were employed and a few excellent results were obtained. But although the unfiltered tubes were superior to other methods of direct application, they were found unsuitable for routine use, and in 1925 the glass filter was

replaced by gold. Accessible locations in various parts of the body were chosen for experimental work in order that reactions and results could be easily observed, after which the gold seeds were used in rectal tumors. Better results were obtained and soon the gold filter replaced the glass for routine work. Larger doses could be given with less constitutional and local reaction. The thickness of the filter, 3/10 mm. of gold, eliminates 97 per cent of soft rays, so that sloughing has become a rarity. The seeds are 4 mm. long and 0.75 mm. in diameter with a strength varying from 1 to 3 millicuries. Tubes or "seeds" ranging from 1.50 to 2.25 mm. are most serviceable. The size and the radiosensitivity of the tumor determines the dose for the favorable case: this should be of sufficient strength to eradicate the lesion in one treatment, as secondary doses are less efficient. The amount of emanation necessary for this result may vary from 10 to 65 mc., *i.e.*, 1,300 to 8,500 mc. hours. The unfavorable case is not given sufficiently massive doses to destroy the growth but is treated along palliative lines with small doses that are repeated and vary in accordance with the progress of the case.

TREATMENT BY APPLICATION OF GOLD SEEDS

The most efficient method of radiating rectal cancer is by careful and uniform implantation of gold emanation seeds into the tumor mass. The ultimate objective in all favorable cases is to distribute evenly throughout the primary mass sufficient dosage to provide adequate radiation of all malignant tissues. Over-dosage produces necrosis and sloughing; inadequate doses result in palliation but not eradication of all cancer cells. Failure or success depends upon accurate distribution of the seeds, with proper dosage. Thorough knowledge of the local anatomy and familiarity with the use of rectal specula are essential in such implantations. An electrically lighted proctoscope, 2 cm. in diameter and 15 cm. in length, is suitable for routine work, but special specula of varying sizes are necessary in certain instances. Anesthesia facilitates implantation only in low lying tumors. The patient should be placed in the knee-chest or dorsal position, the speculum inserted, and the gold seeds distributed throughout the mass by long trochar needles. The resistance communicated by the long needles determines the boundary of the indurated mass. A clear field for implantation is maintained by suction. Constricting tumors of the upper rectum are often more adequately treated by inserting seeds both from above and below, when the patient has a colostomy. The lower section is treated with a proctoscope through the anus, whereas the upper section is reached by passing the instrument downward through the colostomy opening. Tumors situated near the anal canal are treated by direct vision through the speculum or by the sense of touch. In the latter instance, the index finger is placed within the rectum to guide the distribution. The needles are then inserted through the lumen of the anal canal, the perineum, or the posterior vaginal wall. This technic provides an even distribution of radium. Additional advantages are afforded by combining the implantation method with that of external radiation.

EXTERNAL RADIATION OR DEEP THERAPY

Although less efficacious than emanation seeds, external radiation is the first step in treatment: it is applicable to all cases and determines the tumor radiosensitivity. As external radiation alone is capable of causing complete eradication of the disease in the most radiosensitive type of tumor, no other form of treatment may be necessary in this type. It is the ideal method of radia-

tion, in that it never produces trauma, infection, nor sloughing of the tumor. Not only does the tumor mass receive uniform radiation, but the surrounding lymphatic areas are also influenced. Unfortunately, sufficient dosage cannot always be given, owing to the depth of the tumor mass and the susceptibility of the skin to irradiation, to cause complete disappearance of the cancer. This deficiency, however, in the favorable case is conveniently supplemented by the implantation of emanation seeds. The efficiency of external radiation depends upon the dosage of gamma rays reaching the tumor mass. An erythema dose given at a distance of 10 to 15 cm. from the skin through several portals of entry provides moderate dosage at the site of the tumor. Mathematical estimation of the dose reaching the tumor mass in the form of an erythema dose may be determined for the various types of applicators by accurate measurements.

Until recently the most efficient form of external radiation was the emanation pack, with a dosage of 10,000 mc. hours at 6 cm., and 18,000 to 20,000 mc. hours at a distance of 10 cm., with an interval between treatments varying from one to three days. During the past six months the addition of the 4 gram element pack has permitted the application of larger doses. This pack has been used at a distance of 15 cm. from the skin, utilizing from two to four portals of entry. The preliminary results of this extensive radiation are encouraging. Adequate protection of the patient by heavy lateral screening of the radium permits the administration of the maximum dosage at a distance of 15 cm., with a resulting mild constitutional reaction. Forty-five to fifty-five thousand mc. hours may be safely applied at each portal, provided the dosage be divided and extended over a period of three to four weeks. High voltage X-ray may be substituted when a sufficient amount of radium is not available. Our routine pelvic cycle of X-ray therapy includes two anterior and two posterior portals, with an additional perineal field when the tumor is low in the rectum. An erythema or sub-erythema dose is given at each portal. The treatments vary from 240 to 300 milliampere minutes, with a spark gap of 14 cm. and filter of ½ mm. copper and 2 mm. aluminum, with a focal distance of 50 cm.; administrations are separated by a two- to four-day interval.

External radiation is equally advantageous for favorable and unfavorable patients. The complete course of treatments for the favorable patient is outlined at the beginning, and each step is carried out in a systematic manner. Satisfactory results are seldom obtained by haphazard methods of treatment. On the other hand, the course of treatment of the unfavorable case is not fully determined at the beginning, as the prognosis of the case determines the extent of subsequent procedures. A large amount of external radiation may be given provided the dosage at each portal is always kept below the tolerance of the skin and regulated according to the physical condition of the patient. Impairment of the skin practically discontinues the usefulness of this method.

REACTIONS TO RADIUM TREATMENT

Erroneous impressions regarding reactions following adequate treatment are responsible for many patients being deprived of the numerous advantages afforded by radiation. These impressions originated when radium treatment of rectal cancer was in the experimental stage. At that time radiotherapy was in its infancy, and, in addition, cases were improperly selected. Crude technic and inadequate dosage produced unsatisfactory results: surface applicators, tubes in tandem fashion, and element needles produced unnecessary reaction, since not only the malignant tissues but large areas of normal tissue received heavy radiation. With such methods, the difficulty of ob-

taining adequate radiation of an irregular tumor without damage to normal tissues is evident to every proctologist and radiologist.

At the present time reactions from irradiation vary in accordance with the location of the tumor, the dose administered, and the idiosyncrasy of the patient to radium and X-ray. External radiation and small doses of emanation frequently produce no undesired results. However, about 20 per cent of patients have a mild reaction characterized by nausea, lasting a few hours, a slight increase in mucous discharge, and a feeling of general malaise for a day or two. Seldom are these reactions sufficiently severe to interfere with the patient's daily duties. The massive dose of radium emanation required for large tumors of the favorable type may produce a moderate reaction, as evidenced by a slight loss of appetite, flatulence, general malaise together with an increased amount of mucus and pelvic discomfort. The blood picture is slightly reduced and accompanied by a moderate loss of strength. Reactions are greatly diminished by taking large amounts of easily digested food and by daily evacuations. Gold implantations do not introduce infection within the tumor mass to any recognizable degree. There is sloughing in but few cases except through over-dosage or secondary applications. Untreated, rapidly infiltrating tumors of either the slowly or rapidly growing type are prone to sloughing and to hemorrhage; therefore, in this type of tumor, these reactions must not be attributed to the use of radium.

Pain is a late and severe symptom of rectal cancer. It does not occur until the disease has invaded the adjacent tissues, which may be highly supplied with nerve filaments. Irradiation of a painful tumor causes increase of pain during the period of increased inflammatory reaction, but irradiation of a non-painful tumor does not produce actual pain. In the former case, although increased for a time, pain ceases with the subsidence of the inflammatory reaction. Increased micturition is present only after extensive radiation of tumors of the anterior rectal wall or those that lie adjacent to, or involve, the bladder. Filtered emanation produces a less severe, but somewhat more prolonged, reaction than unfiltered. However, it is reasonable to expect a certain amount of discomfort from any form of treatment capable of producing clinical cure in cancer of the rectum. The reactions and danger of adequate radium treatment cannot be compared with those of radical surgery.

SURGERY OF RECTAL CANCER COMBINED WITH RADIUM TREATMENT

Surgery, in the form of colostomy or extirpation of tissue, occupies an important position in the treatment of rectal cancer. In the presence of obstruction, colostomy is imperative; in its absence, this procedure aids but little in the majority of cases. In the event of radical surgery, a preliminary colostomy lowers the mortality. This procedure also permits exploration of the abdomen to determine the presence or absence of metastases, and gives valuable information in reference to subsequent treatment, particularly in the early disseminating types of tumors. It is advantageous in tumors situated high, showing partial obstruction, where additional emanation is needed at the upper limit of the mass. Colostomy should not be performed unless it affords a real additional advantage to treatment, especially in males of advanced age to whom this condition is particularly objectionable. The improved technic of radiation of rectal cancer in the past two years has greatly lessened the necessity for this operation.

In a certain number of cases radical surgery is valuable. It is, however, more valuable when combined with irradiation than when used alone. The reason for this is the high percentage of early recurrences

and of incomplete removals following resection. The rationale of this treatment consists in destruction of the disease by radium and subsequent removal by surgery of the devitalized mass, absorption from which is detrimental to the patient. Devitalized tumor tissue is removed by resection of the rectum, usually seven to fourteen days following irradiation. The action of radium does not appear to increase to any marked degree the difficulty of surgical procedure, or decrease the resistance of the patient, providing that a period of not more than three weeks intervenes between procedures. Should a small area of tumor tissue remain after operation, it may be treated by suitable dosage of filtered emanation.

CASE REPORTS

The following cases demonstrate the variation of treatment essential in different types of tumors and stages of the disease.

Case 1. Young male, inoperable case; actively infiltrating, radiosensitive tumor; ulcerating adenocarcinoma, Grade III. *Treatment:* colostomy; external radiation. *Result:* free of recognizable cancer for eleven months. This patient, 34 years of age, pale, anemic, weighing about 120 pounds, was referred to Memorial Hospital, April 19, 1926. *History:* frequent stools with blood and mucus; constipation for six months, with a loss of weight of 15 pounds. Rectal examination disclosed a large definitely fixed tumor mass 10 cm. from the skin margin of the anus, producing marked constriction of the lumen of the bowel. The upper limits could not be determined. Moderate bleeding and superficial ulceration were noted.

Treatment was as follows: From May 5 to May 19, a routine pelvic cycle of high voltage X-ray was given; a colostomy was performed on May 29. Exploration revealed a large, fixed tumor mass, just below the reflection of the peritoneum, with many large nodes in the lower mesocolon. The X-ray cycle was repeated in June, and again in August, with only very slight reactions following these treatments. On July 13, the patient was absolutely free of any rectal symptoms although a mass of considerable size was still present in the upper rectum. Despite the absence of symptoms the following treatments were given: a pelvic cycle in November and a single X-ray treatment in December. On January 11, 1927, 20,000 mc. hours from the emanation pack were administered posteriorly over the sacrum, and a final pelvic X-ray cycle was given in March, 1927. This patient has remained well since July, 1926, and there has been no recognizable tumor of the rectum since January, 1927.

Case 2. Male, 65 years of age; inoperable case; uniformly growing, infiltrating and disseminating tumor; adenomalignum, Grade II. *Treatment:* colostomy, external radiation, implantation of gold seeds. *Result:* free of recognizable cancer for one year.

This patient was admitted to Memorial Hospital in March, 1926. History of constipation with the passage of blood and mucus for a period of three months. On February 27, before the patient fell into our hands, a colostomy had been performed, since the tumor was considered inoperable. Local examination revealed a large constricting cancer of the upper rectum, definitely fixed in all directions to the surrounding structures. The lumen was much narrowed and the mass, which showed superficial ulcerations, bled moderately when traumatized. On March 12, 25 gold-filtered seeds totalling 35.7 mc. (4,700 mc. hours) were inserted into the lower section of the tumor, and on March 15, 6 gold seeds totalling 15.4 mc. (2,030 mc. hours) were inserted into the upper limits of the tumor, by passing the proctoscope downward

through the colostomy opening. A pelvic cycle of X-ray therapy consisting of four treatments was given between March 17 and April 2. The patient was uncomfortable for several weeks, as considerable reaction followed these treatments. Examination on May 21 showed marked reduction in size of the tumor. The patient did not return to the clinic for several months; on October 6, he was reported to be in good health, with his physician unable to find any evidence of cancer. On his return to the clinic in January, 1927, he was clinically free from cancer of the rectum and has remained so until the present time, November, 1927.

Case 3. Male, 52 years of age, inoperable case; slowly growing, rapidly infiltrating tumor; adenomalignum, Grade II. *Treatment:* colostomy, external radiation, implantation of gold seeds, excision; postoperative radiation and gold seeds. *Result:* free of recognizable cancer for two years.

This patient was referred for treatment September 28, 1925, giving a history of burning in the rectum, bleeding, mucous discharge, and constipation for one year, with a loss of weight of 15 pounds. Local examination revealed an irregularly shaped, fixed tumor involving the lower rectum and upper limits of the anal canal. *Treatment:* a pelvic cycle of X-ray treatments was administered from September 30 to October 14. On October 5, 10 gold seeds, a total of 34.7 mc. (4,580 mc. hours), were distributed throughout the tumor mass. Special effort was taken to place these seeds into the infiltrated area which extended considerable distance beyond the rectal wall. A colostomy was performed, October 23, and a radical resection, November 2. At the time of operation it was uncertain whether all the irradiated tissue had been removed, because there was a marked extension of the growth on the right side of the rectum; therefore, the wound was left open for observation. Convalescence was uneventful, and healing satisfactory, except for a small area at the right of the prostate. In this suspicious area we implanted 4 seeds totalling 7 mc. emanation. The wound then healed rapidly and the patient left the hospital in good condition. He has remained free of recognizable disease, has gained 40 pounds, and feels better than for three years previous to this treatment.

Case 4. Male, aged 29, inoperable case; uniformly growing, infiltrating and disseminating, radioresistant tumor; adenoma destruens, Grade I. *Treatment:* colostomy; many applications of external radium and emanation seeds. *Result:* marked palliation.

This case demonstrates the course of palliative treatment in an unfavorable condition. The patient was referred to the hospital December 17, 1924. History of constipation with passage of blood and mucus for over six months, accompanied by loss of weight of 20 pounds. A colostomy had been performed six weeks previously in another hospital, at which time the tumor was termed inoperable. Local examination revealed a large, definitely fixed tumor mass situated in the middle of the rectum.

The patient was treated in the following manner: November 19, 20,000 mc. hours of radium at a distance of 10 cm. were applied over the sacrum; December 24, the same dose was given anteriorly over the pubis. December 27, 30 glass-filtered seeds (2,600 mc. hours) were distributed within the tumor mass. During December he also received a pelvic cycle of high voltage X-ray therapy. Bleeding stopped and the mucous discharge was markedly lessened. The tumor was reduced in size and the patient's general condition greatly improved. By March, 1925, he had gained considerable weight and the only remaining symptom was the passage of a small amount of mucus once or twice daily. During 1925 he received two X-ray treatments in March, two in May, one in June, and two in July. On Septem-

ber 19, 22.8 mc. of gold seeds were implanted in the tumor. In 1926, the following treatments were given: in February, one pelvic X-ray treatment and 14 mc. of gold seeds; in April, 12.9 mc. of gold seeds were implanted into the upper limits of the tumor by way of the colostomy opening. In July, as he began to have frequent passage of mucus and blood and the tumor still showed activity at its upper limits, 18 mc. of gold seeds were implanted. During August, a large amount of blood was passed in the urine. Cystoscopic examination revealed a marked inflammatory reaction at the base of the bladder, with several ulcerating areas which resembled carcinomatous tissue. The bladder was irrigated with 1/5000 silver nitrate. X-ray pelvic cycles were given in August, October, and December. In December he was again practically free of symptoms. During 1927 he received three X-ray treatments in February and a complete cycle in May. This patient required a somewhat more extensive course of treatments to control the disease than does the average patient. However, there were no severe reactions following these treatments. He was able to carry on his occupation as a chauffeur for the majority of the time since coming under observation. At present his general condition is good and his weight remains normal, although he passes mucus, which is occasionally bloodstained, two or three times daily.

RESULTS

The majority of patients with cancer of the rectum that have been referred to Memorial Hospital were inoperable cases. Nevertheless, this advanced group has provided material for a careful study of the disease, and afforded the opportunity of determining the value of radiotherapy. In the beginning, cases were improperly selected for treatment, and numerous forms of inefficient applicators were employed, with the result that many patients did not receive benefit equal to that afforded by the present-day technic. Since June, 1925, we have made routine use of gold seeds, with a great improvement in our results. Of the cases treated previous to that date, many were afforded marked palliation, and nineteen of these patients are still alive and clinically free of cancer, over intervals varying from two and one-half to seven years.

A cross-section of the more recent work is shown by a review of cases admitted to the hospital from July, 1925, to July, 1927. In this interval we have been able to follow one hundred cases, studied and treated in accordance with methods as set forth above. Twenty-three patients were considered favorable and seventy-seven unfavorable. The unfavorable group was subdivided as follows: twenty suitable for extensive palliative treatment; thirty-four suitable for mild palliation, while twenty-three were unfavorable for treatment. Of the twenty-three patients comprising the favorable group, three are dead; one patient still has disease; another is questionable for disease, while eighteen are free of recognizable rectal cancer. Of the twenty patients who received extensive palliative treatment, eighteen are still alive; of these, seventeen were greatly benefited by treatment. Two are dead, one of cancer and the other of bacteriemia, eighteen months following treatment. This patient had been symptom-free for six months, and autopsy failed to show any evidence of cancer. Thirty of the patients receiving mild palliation were benefited, while four failed to respond to treatment. Thirteen of these patients are alive now. Adequate palliative treatment in the unfavorable cases reduced the severity of symptoms and in many instances prolonged life.

CONCLUSIONS

1. The most important factors of successful treatment of rectal cancer lie in

early recognition and careful classification of the disease, in accordance with the general physical conditions of the patient. Classification must be understood to include: (*a*) location of growth; (*b*) degree of malignancy; (*c*) local extension and distant involvement of tissue by tumor cells; (*d*) radiosensitivity of the tumor cells.

2. If radium is employed, its proper use is absolutely necessary for eradication of the disease. Element needles and tubes in tandem fashion are of only low grade palliative power in rectal cancer. Whereas we have obtained certain excellent results by using bare tubes (glass seeds), our later experience has shown the method of choice to be gold seeds.

3. In selected cases, a combination of radium and surgery is the method of choice.

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DISCUSSION

Dr. Albert Soiland (Los Angeles): I regret that the time is so short for discussion, because this field of endeavor is the only remaining one wherein radiotherapy has been challenged, and where we are on less secure ground, perhaps, than in any other part of the body. If we had time, we should take this subject up critically. In institutions where surgery and radiation can be combined scientifically, there is no question of the value of radiation, but, unfortunately, the average surgeon is so located that he cannot always have the use of radiation in such institutions as that of our good friend, Dr. Lacassagne, who works with Professor Régaud, where they have radium in large quantities, and know how to use it. Their results are attained with this type of radiation, which many of us have not yet approached. I was very much pleased to hear the surgeon from New Orleans [Dr. Allen] credit radium therapy with a certain amount of usefulness in rectal cancer. I was also glad to hear Dr. Schmitz elaborate on the classification. It is to be hoped that we can have time at some meeting in the immediate future to thoroughly study the subject of rectal cancer from a radiation treatment standpoint.

Dr. Binkley (closing): I agree with Dr. Allen[1] to a certain extent, in that tubes arranged in tandem fashion are of slight palliative value, but consider gold filtered emanation seeds to be far more efficient. These seeds may be inserted into tumors of the upper rectum by way of the lower section of the sigmoid, with a proctoscope inserted downward through the colostomy opening, as satisfactorily as through the anal canal. The second case report demonstrates the efficiency of this method. Inefficient radiation of the cancer cells and the objectionably severe reactions are the reasons for not employing the tandem method of treatment. Diathermy and the endotherm knife have been used in a few cases, but we have not been impressed by these methods in either the favorable or unfavorable group. Tumors in the lower rectum are usually of high grade malignancy and when in the favorable class they require radical treatment. If surgical removal is indicated, clean dissection with scalpel and scissors offers the most satisfactory method.

This classification of rectal tumors is

[1] Dr. Allen's discussion has not been received for publication.

somewhat complicated, as it embodies numerous factors, but it is more serviceable than the division of these tumors, in accordance with the extent of the local disease, into operable and inoperable groups. Perhaps I failed to make the distinctions of the different groups quite clear, in that, although tumors are inoperable, they may nevertheless be favorable and that all operable tumors are not favorable. We have a number of cases that were termed inoperable at other institutions which are now clinically free of disease, due to the use of radium and X-ray therapy. Because of the variation in the clinical aspects of the disease we feel that a classification, to be of the most value, must include the radiological, as well as the surgical factors.

Clinical and Roentgen-ray Findings in the Healthy Adult Chest. Report of the Committee of the National Tuberculosis Association. Am. Jour. Roentgenol. and Rad. Ther., May, 1927, XVII, 507.

This important article is a report of the X-ray findings of 280 clinically healthy adult chests and represents the work over a three-year period of three roentgenologists and three clinicians appointed by the committee on medical research of the National Tuberculosis Association.

Two age periods were considered: persons between the ages of twenty and thirty and persons forty-five years or older. The so-called "normal" in the X-ray studies included cases showing: (1) costophrenic pleural adhesions if no other definitely abnormal findings were noted; (2) calcified nodes in the hilum where no pulmonary changes were seen; (3) thickened trunk shadows without fan shadow or pleural thickening; (4) tracheal deviation without lung, pleural, mediastinal, or spinal pathology, and (5) slight interlobar thickening.

The term "healthy chest" was recommended for adoption in preference to "normal chest," also "dome of diaphragm" rather than "diaphragm."

The hilum, roentgenologically, was described as a hazy shadow, irregular in outline and density, but fairly constant in extent, the lateral-most border being within the inner third of the lung field and the vertical distance being two interspaces and a rib on the right and slightly less than this on the left.

The subdivisions of the right and left bronchi were identified and their courses and distributions to the various lobes carefully described.

The routine use of the lateral view of the chest was urged, following which a detailed description of the appearance of the healthy chest taken in this position was given. This description should be of much value to the roentgenologist who makes the lateral exposure only when definite pathology is encountered.

J. E. Habbe, M.D.

SAFETY STANDARDS OF PROTECTION AGAINST X-RAY DANGERS[1]

By A. MUTSCHELLER, PH.D., NEW YORK

THE importance of the questions of protection and standards of protection against X-ray dangers is fully affirmed by the frequent discussions in the literature of the dangers to which radium and X-ray operators are exposed and the steps of precaution that should be taken to avoid or to minimize them; but in this connection there is also frequent mention of the necessity of knowing exactly the largest dose of stray radiation to which radium and X-ray operators can be exposed without ultimately being caused to suffer harmful effects or dangers that later in life might result in health deficiencies. The exact knowledge of the dose that thus can be tolerated is requisite because of a condition of equilibrium which exists between the necessity of providing sufficient protection, on the one hand, and of preventing the apparatus from getting too large, heavy, costly, and cumbersome to manipulate, on the other.

In a paper (1) presented in 1925, at the meeting of the American Roentgen Ray Society in Swampscott, I undertook to calculate the thickness of lead, or its equivalents, required to provide adequate protection for operators against radiation dangers. It was also reported in that paper that operators are exposed to a stray radiation dose of 1/100th of an erythema dose per month with equipments that now are considered absolutely safe, and that an operator may be continually exposed to this dose without suffering injuries to his health.

This proposed tolerance dose has since not only been accepted in Germany, but the writer has learned also from Dr. Kaye, during his recent visit to this country, that in England it had already been used to quite an extent as a basis for the calculation of safety standards. Moreover, there are now several independent redeterminations by different methods and by independent investigators of the protection tolerance dose. Therefore it is proposed in this paper to compare and to contrast these with one another with the object of finding how they agree with respect to this proposed tolerance dose, or what average they may yield. Thus we shall be enabled to propose finally a tolerance dose with which we may proceed to set up definite standards of protection against X-ray and radium dangers.

In order, however, to be consistent, all data from the different publications should be for the same conditions, such as the same amount of work performed, the same time during which the source of the radiation is in operation, the same intensity and wave length of the radiation generated, etc. The data from these publications are, therefore, correspondingly recalculated for uniform conditions.

It is, of course, also true that in a laboratory in which only a small amount of work is to be performed, a lesser measure of protection might be sufficient. But it does not seem to be safe or advisable to consider any other condition than that of a laboratory in which the maximum amount of work is performed. The chance of mistakes or of forgetting limitations in the protection might so easily lead to errors with serious consequences, that only the large amount of work performed in a busy laboratory will be considered for the calculations and considerations that follow. As outlined in a former paper, the following exposure times and radiation intensities may be assumed as representing such working conditions:

(*A*) For radiography, 50 exposures of an average of 5 seconds with 20 ma. per day (average = 0.35 Å.U.).

(*B*) For fluoroscopy, 2 hours' exposure with 4 ma. per day (average = 0.30 Å.U.).

[1] Read before the Radiological Society of North America, at the Thirteenth Annual Meeting, at New Orleans, Dec. 2, 1927.

(*C*) For surface therapy, 10 hours' exposure with 4 ma. per day (average = 0.25 Å.U.).

(*D*) For deep therapy, 10 hours' exposure with 4 ma. per day (average = 0.14 Å.U.).

In an ingenious way of adapting a photographic method for measuring the intensities of stray radiations, Edith H. Quimby (2) and Charles Viol (3) measured the total intensity of stray rays received by operators of X-ray equipment and of radioactive elements. E. Quimby also tested and measured the influence of the variation of conditions such as the effects of weak radiation for a prolonged period, against more intensive radiations for a shorter time, and the influence of the effect upon the film of very small radiation intensities. Thus, all the possible errors from such sources are determined and eliminated, which surely makes this method dependable for reliable results. The estimation was made by causing the workers to carry unexposed films on their persons for the period of one week. The tints so obtained, after developing the films, were then compared with tints obtained from known radiations on other films developed and otherwise treated by the same process. A photometric comparison of the tints obtained revealed that the weekly dose sustained by these workers, through the protection provided at the Memorial Hospital in New York, consists of 0.0031 skin unit dose. In one month's time this would sum up to 0.0124 skin unit dose.

With an electroscope similar to that described by myself (16), H. Fricke, Beasley (4), and Jacobson (5) measured the intensities of stray radiations from various therapeutic equipments located in and around Cleveland and New York. In these laboratories they found the average monthly dose to which the operators were exposed to be 0.065 skin unit dose. But several readings not included were reported as less than 0.025 skin unit dose per month, which would naturally make the above mentioned average dose considerably smaller and thus come very near the value of the proposed protection tolerance dose. The extent of protection in the laboratories in which these measurements were made appears to be fully adequate, according to the present state of our knowledge, and thus all the requirements for adequacy in every respect seem fulfilled.

About two months ago, I had the great pleasure of receiving a hitherto unpublished manuscript from Dr. Barclay, of Manchester, England. Dr. Barclay stated that he had performed the experimental work therein reported before he had knowledge of my earlier publications. His physicist carefully calibrated an iontoquantimeter for measurement of small intensities of stray radiations in terms of erythema doses. With this instrument he measured the stray radiations to which several of his assistants and he himself were exposed. He found that one woman technician was exposed to 1/140th of an erythema dose daily during the working days. This is the largest stray radiation dose that he measured and it tends to show that in certain cases surprisingly large doses may be tolerated. But although this technician does not show any evidence of injury to body or health, there may be impairment of the more radiation-sensitive genital organs. There may be several influencing factors such as numerous and prolonged holidays, much exercise in the open, etc., which would all help to make these large doses tolerable, yet, to offset these doubtful factors, Dr. Barclay proposes a very large safety factor of 1 per cent of the measured radiation quantity as a safe tolerance dose. This safety factor then makes his tolerance dose considerably smaller than mine, but in a letter which I recently received from him, he states that he is fully in sympathy with a safety factor of 25 per cent. His safety tolerance dose then becomes 0.017 skin unit dose, which brings his tolerance dose very

close to mine, and, within the limits of experimental error, they are identical.

Of interest in this connection, although not constituting direct experimental confirmation of the safety tolerance dose, is the fact of the adoption of the proposed tolerance dose by numerous writers such as R. Glocker (6, 7, 8), Landauer (9), Th. Neeff (10), Rigèle (11), Schlechter (12, 13), Hausser (14), and others. These writers based their calculations for protection shielding or other problems in connection with protection on this dose, and, as their publications show, there are no indications of inconsistency or any evidence tending to show that the proposed dose is either inadequate for safe protection or too large for practical purposes.

When the results obtained from different types of installations are tabulated, as, for instance, in Table II, they lend themselves to interesting interpretation. Groups 1, 2, and 3 contain numerical values of stray radiation intensities which are slightly larger than the assumed tolerance dose. But there are also measurements reported in the publications from which these data are taken which are smaller than the tolerance dose, and of which the exact numerical value is not given, because of the fact that the measuring methods employed are not quite sensitive enough to give an exact result. While, therefore, the first three groups reveal stray radiation doses that are slightly larger than the proposed tolerance dose, it must be kept in mind that if the smaller, not accurately determined values were included, the average would be considerably smaller, and this, then, brings the correct representative value of the averages of the first three groups into very close proximity to the proposed tolerance dose. At this moment, therefore, there is no reason for either increasing or decreasing it.

Group 4, on the other hand, includes measurements, all of which were made with one kind of equipment. The stray radiation doses measured are 10 erythema doses, which is about a thousand times larger than the assumed tolerance dose. But the conditions of protection for the operator which gives him this insufficient extent of protection against stray radiation doses are a tube partly enclosed in a lead glass shield with the operator placed behind a flat single panel lead screen inside of the treatment room, together with the tube and the patient. It must be admitted that such conditions of protection would not be accepted, even without any knowledge of the actual stray radiation intensity, and no conscientious department head would tolerate such exposure of his assistants. The only reason why no injuries to health have thus far been actually produced through the use of such inadequate protection for the operator, is that usually the exposure times made with such equipment are much less than those which we have assumed for our calculation. This method of protection, namely, that in which the tube is only partly enclosed, requires special attention, for it seems that the dangers from such arrangement of protective screens have never received the attention which they deserve.

Now that averaging of several independently conducted experimental determinations of the tolerance dose by different methods has led to practically identical results, it would seem that the value of 1/100th of an erythema dose could be depended on as the safety tolerance dose and be considered as representing that stray radiation dose per month to which the average radium or X-ray worker or operator can safely be exposed continuously, provided that the usually required sanitary and recreational rules are not neglected.[2]

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[2] R. Glocker, *l.c. cit.*, has expressed the safety tolerance dose in terms of 1/20,000th skin tolerance dose per hour, instead of 1/100th of a skin tolerance dose per month. While these statements are mathematically identical, it seems that the former is not taking duly into consideration the difference of effectiveness of a dose administered in a short time and one equally divided over a period that is at least as long as the accumulative period, so as to really represent practical conditions.

It appears clearly from an inspection of Table II that the protection devices nowadays most frequently employed can be divided into two distinct groups. One group would then contain the types of shielding in which the tube is completely enclosed within a sufficiently radiation-opaque shield so that the directly transmitted primary radiation intensity is not over 10 per cent of the total stray radiation. Whether or not the patient should be inside or outside of this enclosure is a topic that can not be discussed here; but the operator, in order to be safe, must invariably be located outside of the enclosure,[3] and, in addition thereto, he must be adequately protected against the stray radiation from the patient, the table, and the floor.

The second group of protective equipments comprises those in which the tube is only partly enclosed and where the operator is in the same room with the tube. A typical representative of this group is the lead glass bowl or the lead glass shield through which the terminals of the tube project. If the operator is stationed in the same room with the tube, then he is exposed to the dangerous stray radiation coming from the stems of the X-ray tube, the glass walls and other parts of the tube housing. Measuring the intensity of stray radiations coming, for instance, from the tube housed in a lead glass shield mounted in a typical stand employed for fluoroscopy shows that the stray radiation intensity is so great that only 1/10th of the amount of work, or an average of only 12 minutes of fluoroscopic examinations per day, are feasible without exceeding the tolerance dose. A similar ratio of 1/10th results when therapy is attempted with a tube in an open lead glass bowl or in a lead glass shield. These limitations are of sufficient importance to justify special precautions in recommendations for equipment in which the X-ray tube is only partly surrounded with protective material, without additional protection such as in the well known lead glass bowls and shields.

Several roentgen-ray societies have appointed Safety Committees, and, of these, notably the X-ray and Radium Protection Committee of England, in May, 1927 (15), and the German Roentgen Society, also in 1927 (7), issued safety rules and recommendations. These safety rules, while in themselves very complete, thorough, and commendable, are not entirely consistent or uniform, for, in one instance, the thickness of protection material specified is insufficient for adequate protection and in another case too great a thickness of protective shielding is demanded. Therefore, a recalculation of the correct thicknesses of protection material for various conditions of tube excitation, on the basis of a consistent and experimentally sufficiently verified tolerance unit dose, is probably well justified (16).

The total thickness of lead required for adequate protection, calculated as outlined, is as follows:

(*A*) For radiography, not less than 2 mm. of lead;

(*B*) For fluoroscopy, not less than 2 mm. of lead;

(*C*) For superficial therapy, not less than 3.25 mm. of lead;

(*D*) For deep therapy, not less than 5.6 mm. of lead.

When the X-ray tube is supported in a lead glass shield or bowl such as are quite extensively employed for radiographic, fluoroscopic, and even for therapeutic work, and the operator is in the same room without additional protection such as screening, then, no matter how thick the protective walls which partly enclose the tube are made, the stray radiation intensity still remains and a greater extent of protection is not obtained.

[3] The operator might also be located in a completely enclosed lead-lined booth. But on account of the difficulties of providing adequate ventilation, this method of protection should be avoided.

TABLE I

	Author	Average Value for a Safe Protection Tolerance Dose
1.	E. Quimby and Viol	0.0124 and less[4]
2.	Fricke and Jacobson	0.065 and less[4]
3.	Barclay	0.017 (safety factor of 25%)
4.	A. Mutscheller	0.010 (from only perfectly protected installations)

[4]These average values do not include several determinations reported as less than 0.025 skin unit dose. If the exact values had been given and included in the averages, the above figures would be considerably smaller, and they would, therefore, come still closer to the dose of 0.01 skin unit dose.

TABLE II

	Tube	Operator	Average E. D. per month
1.	All enclosed in Pb box	In separate room, Pb lined	0.0126[5]
2.	All enclosed in Pb box	In treatment room behind Pb screen	0.105[5]
3.	Partly enclosed in Pb glass bowl	In separate room, Pb lined	0.0775[5]
4.	Partly enclosed in Pb glass bowl	In treatment room behind Pb screen	10.25

[5]These average values do not include several determinations reported as less than 10–4 skin unit doses. If the exact values had been given and included in the averages, then the above figures would have been considerably smaller.

Measurement of the radiation intensities indicates that the amount of work that can be performed with a partly enclosed tube may be not over 1/10th of that outlined in an earlier part of this paper. Otherwise, the safety tolerance dose is considerably exceeded and for a larger amount of work such equipment can not be considered as safe and permissible.

As it is obviously desirable for a clinician to be in a position to test the protection adequacy of his equipment, there is outlined in the following a simple and sufficiently accurate method of making such a test. An ordinary slow Eastman Dental Film is wrapped in black paper and so exposed to the radiation from a standardized X-ray therapy equipment as to be subjected to 1/400th part of an erythema dose. For example, if the equipment is calibrated and it is known that it produces an erythema dose in 70 minutes at 50 cm. distance, then the film is placed at a distance of one meter from the target of the tube, and, without

changing any filters, it is given an exposure of 70/100ths of a minute, or 42 seconds. This exposure upon the film is equal to 0.0025 erythema dose. Another film is similarly wrapped in black paper and placed where the operator is normally located, or it is carried by him under his clothes on the front part of his chest for a quarter of a month, or for eight days. The films are then developed together but the developing process is interrupted after the lapse of about four-fifths of the normal developing time. This is done to avoid chemical fogging of the films. If the film carried by the operator for a fourth part of a month shows more darkening than the standard film which received a fourth of 1/100th part of an erythema dose, then the tolerance dose of 1/100th of an erythema dose per month is exceeded and the protection appears inadequate. Conversely, if the film is equal in tint or lighter than the standard exposed film, then the protection furnished by the equipment can obviously be considered as safe. In order to exclude the possibility of films being fogged otherwise, it may be advisable to wrap a thin strip of lead foil all around a quarter part of the film. If the films are not fogged and the developing process is carried out correctly, then this part of the film should remain absolutely clear.

In conclusion, I wish to present this analysis of protection tolerance doses, and the value of the dose finally arrived at, to the members of the Safety and Protection Committees, with the proposal to present this unit for international adoption at the Second International Congress in Stockholm in 1928. I am making this proposal at the suggestion or with the approval of certain workers who are particularly interested in protection standards, such as Dr. Kaye of the National Physical Laboratory of England, L. S. Taylor of the U. S. Bureau of Standards, Dr. R. Glocker, who drafted the Safety Rules for Germany, and many others. The adoption of this unit protection tolerance dose would surely lay the foundation for rapid progress in the efforts to avoid repetition of the horrible sacrifices made by the many martyrs who have died as the result of inadequate protection against X-ray dangers.

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16. MUTSCHELLER, A.: Further Studies on Physical Standards of Protection against Roentgen-ray Dangers. RADIOLOGY, April, 1926, VI, 314.

DISCUSSION

MR. L. S. TAYLOR (Washington, D. C.): I wish to say a few words in emphasis of the importance of this work on the tolerance dosage of which Dr. Mutscheller has just spoken. At the Bureau of Standards we have inquiries coming in almost daily on various phases of X-ray work, some of them ridiculous and some rather pathetic, but I believe it is safe to say that 50 per cent of the inquiries concern, in some way or other, questions of safety. For example, "Is such and such an outfit safe in the room below my office? So far as I know, it has no lead protection of any kind. I would like to know if I am in any way endangered by the operation of this X-ray outfit." That is a typical inquiry, and one which, at the Bureau of Standards, we are going to have to deal with as soon as time permits.

In our own laboratory, we follow a rather crude method of photographic test for scattered radiation. Some four months ago I placed about the X-ray equipment at various points where an operator would be likely to be engaged, films, half wrapped in lead and half open (that is, not open to light). At intervals of about a month these films were developed to see if there was any appreciable darkening. Our equipment there is rather excessively shielded, and, as yet, a four months' exposure has showed no darkening on any of the films we have had lying around.

The program on safety, while as yet not definitely under way, is going to be undertaken as soon as the program of standardization is completed. That will probably not be for several months, and, in the meantime, this question of tolerance dosage is continually coming to our attention. I believe it ought to be urged upon this Society, that the Society may make some tentative adoption of tolerance dosage rules of protection. These rules might be published and distributed until such a program can be worked out and tested more thoroughly at the Bureau of Standards. It seems to me that this paper of Dr. Mutscheller's marks the greatest step toward protection that has yet been made, and I believe it is one which ought to receive the serious attention of all workers.

DR. OTTO GLASSER (Cleveland): I feel we ought to congratulate Dr. Mutscheller for promoting the discussion of this problem of protection from radiation. It appears especially important that the definition of the tolerance dose as a safety standard should be something which we actually can visualize. To say, as we are accustomed to do, that to obtain sufficient protection we must use so many millimeters of lead may be accurate for certain conditions of radiation, but cannot be generally applied throughout the whole range of qualities of radiation. If, on the other hand, we are able to measure the dose as it actually comes through a certain amount of lead, in *R*-units, for instance, then we have an actual standard of measurement. I feel also that this question of protection should be brought before the International Congress in Stockholm this summer and that for protection a safe tolerance dose should be suggested. We must, of course, realize that the present value of the tolerance dose, as suggested by Dr. Mutscheller, is still a rather uncertain conception of this dose, because it is very hard to find workers, injured by X-rays, in whose cases the dose which has caused the injury can be accurately calculated or estimated. For the last few years we have been measuring radiation which reaches the operator in a number of clinical laboratories by means of a

special protection electroscope described by Fricke and Beasley. In each instance we tried to obtain from the laboratories calculations of the total time during which the operator was exposed to the radiation. Our experience proves that for the most part it is almost impossible to obtain exact and reliable data in this way. Exact data as to the time of exposure may be available, but not as to the intensity of the rays, for the operator receives radiations of different qualities, from the soft secondary β-rays up to the very penetrating X-rays, which are filtered through lead. Thus, although a tolerance dose should be recommended and adopted, many more years of investigation will be necessary before even an approximation of the exact value of the safe tolerance dose can be reached. The tolerance does of 1/100th of an erythema dose per month or of 10 *R*-units per month seems to be a rather safe amount. Perhaps we can increase the dose of tolerance in the future, but, for the time being, Dr. Mutscheller's tolerance dose should be accepted as the standard of safety.

Dr. Ancel St. John (New York): Dr. Mutscheller has done well to emphasize the equilibrium condition to be sought between adequacy of protection and the cost and convenience of equipment. In view of the increasing use of X-rays for industrial purposes, agreement upon the dosage permissible for personnel is especially important. X-ray installations of this character are likely to be in operation continuously during working hours, in the midst of a busy factory. It is necessary, therefore, to provide adequate protection, not only for the X-ray operators but also for others whose duties require their presence in the vicinity. In this respect such installations resemble the X-ray department of a hospital. It would seem that protection accepted as adequate for use in a busy hospital should likewise be accepted as adequate for similar current, voltage, and time conditions in a factory, but until there is agreement upon what constitutes such adequate protection, and upon permissible dosage for personnel and a means of determining that such dosage is not being exceeded, it will be necessary for industrial installations to use unduly complete shielding in order to avoid complications under workmen's compensation laws.

In this connection the information concerning the character of radiation given off by irradiated objects seems to be inadequate. There is a tendency to speak of such radiation as "secondary" and to think of it as consisting mainly of the characteristic radiations of the object. But experience in technical radiography and consideration of the laws of X-ray absorption both indicate that with low atomic weight materials, such as aluminum, organic compounds—including human tissue, wood, rubber, and the like—water and air, the true secondary characteristic radiation constitutes only a small part of the whole and the major portion consists of true "scattered" radiation of the original wave lengths. The protection afforded by auxiliary shields may, therefore, often be inadequate. This is particularly true when the X-ray tube is not completely enclosed.

Hence, for industrial purposes it is practically essential to have both tube and object completely surrounded by lead or other absorbing material of adequate thickness. This enclosure may be a lead-lined room or a lead-covered drum for the tube combined with a lead-covered cabinet for the object, or some other arrangement capable of preventing all but a negligible amount of radiation from escaping anywhere. Until we have an accepted definition of "a negligible amount of radiation" we will have to lean over backwards and use really excessive

amounts of lead. We, therefore, welcome the step Dr. Mutscheller suggests.

DR. MUTSCHELLER (closing): I am very glad that the practical idea underlying this paper has come so well to the surface, namely, that the case reported by Dr. Barclay is simply a borderline case, which indicates that his dose is about the largest dose, which in this one case just fails to produce damage. Then one twenty-fifth of that is, of course, an arbitrary figure; it might be a thirtieth or a fiftieth or something like that, but the idea is that we should adopt some value tentatively, which now seems safe, so that all over the world it can be used and checked up by others. Such an adoption of a safety tolerance dose would also make possible that uniform data could be accumulated, which will prove either that the dose is too large or too small or just about right. It is simply an intent to place the matter in such form that it can be cross-checked and compared, with the ultimate purpose of arriving at the safety tolerance dose.

ENGINEERING THE X-RAY DEPARTMENT

By B. H. ARNOLD and A. M. OBRIECHT, CHICAGO

SINCE the discovery by Wilhelm Roentgen, X-ray has progressed rapidly from the experimental stage to a position of general service as a useful art. The development of the Coolidge tube has, with standardized technic, made the art a science and the X-ray a highly important and productive unit in the medical armamentarium.

The amount and value of the work that can be and is done by the modern X-ray specialist is surprising, and, in view of the investment incurred, it is desirable that his equipment be kept occupied to its fullest capability. To insure this high degree of efficiency, it is essential that all the factors affecting the operation of an X-ray department or office be given thorough, careful, and experienced planning before any work of construction is undertaken.

As in other lines, the quality and volume of work is intimately associated with the quality of the equipment and particularly with its arrangement. The standards of workmanship, whether on watches or radiographs, are highest when the surroundings approach the ideal. The best work is obtained from good equipment suitably arranged and properly maintained.

The effects of good apparatus and environment are noticeable not alone on the workers, but also on those who have occasion to visit the radiologist, either for professional or educational purposes. The effect of well designed, well arranged, and well finished laboratories is of potential value in establishing the prestige of owner and operator.

For the purposes of discussion X-ray installations may be considered in three classes: first, private offices used only in connection with the owner's practice—little or no referred work; second, private offices doing a large amount of referred work; third, the hospital department.

Private installations of the first class and, to a certain extent, those of the second, are largely located and arranged in quarters which must be taken "as is," while the hospital department is nowadays being located in a part of the hospital built especially for it, and there is opportunity for really constructive effort.

While much of this article will apply to X-ray installations regardless of the conditions governing the quarters, it is primarily concerned with hospital X-ray departments, that is, those departments where the quarters are built to meet the needs of the work and the apparatus. This is a matter of great importance and benefit to those who must work therein, and no hospital building committee should give final approval to the architect's plans until the X-ray department is given as thorough and detailed consideration as any other department. It is not sufficient to leave a certail number of square feet or a few rooms, marked on the blueprints "for X-ray Department." It must be borne in mind that this space is to be occupied by equipment for a highly specialized purpose, which requires its own electric power supply and plumbing. If for no other reason than that of economy, this work should be included with the specifications for similar work throughout the hospital.

An efficient layout requires more than plans and specifications for the electrician and plumber. The combined efforts of architect, X-ray apparatus manufacturer, radiologist, technician, with a bit of an efficiency man thrown in, must be co-ordinated by the layout engineers to produce an efficiently operating department.

A seemingly small, but not unimportant,

factor which the layout specialist will not overlook is that of proper coloring in the various rooms. With the aid of specialists

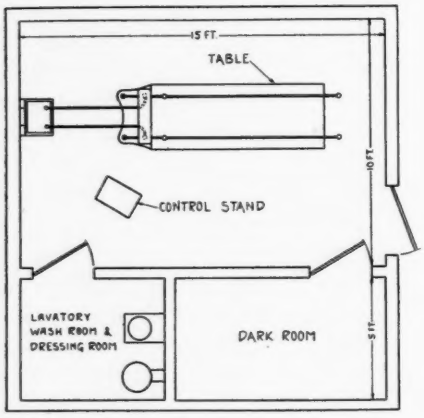

Fig. 1. Limited general-purpose X-ray unit for small hospital or clinic.

in these lines it is possible to give walls and ceilings the coloring which will still further enhance the efficiency of the department as a whole.

The factors involved in planning an X-ray department in the order of their consideration are:

1. Amount and variety of equipment;
2. Space required;
3. Location of the department;
4. Safety—
   (*a*) High tension,
   (*b*) X-ray.

THE EQUIPMENT

The amount and kind of equipment necessary to adequately perform the amount of work to be done must, in the final analysis, rest with the radiographer in charge, he, in turn, being governed by the appropriation for equipment purchase. For financial reasons, it is often necessary to plan a complete department for the future, yet to purchase only the barest essentials for the time-being, depending upon the increase of work to provide funds to complete the installation of all necessary apparatus.

The determination of the proper equipment will require study of the community in which the department is to be located, the character of the work to be done, and, particularly, other institutions of the same size and environment. It is true that tentative lists have been prepared by various authorities as to what a hospital of, say, 300 beds will require, but, naturally, the character of the work in the hospital may vary from this list to considerable extent. Therefore, the lists tend to generality. Improvements in apparatus and changes in technic are especially effective in making lists of this character of preliminary value only.

In view of the foregoing it is believed that the question of equipment can be more safely determined in the various individual propositions, after the perusal of the outlines of the installations and the criticisms thereof, which will be given later in this article. For the purposes of discussion and the statement of certain generalities it is desirable to classify X-ray work, and the following is suggested:

Radiography—the taking of a film for record.

Fluoroscopy—the visual examination, either with or without a record.

Therapy—treatment by X-ray radiation. (*a*) Superficial therapy—approximately 140 K.V.P. (*b*) Deep therapy—approximately 200 K.V.P.

Radiographic work may be subdivided into general radiographic, cystoscopic, and pyelographic, the difference being only in the parts of the body radiographed. For each room there is a table, properly designed and built for the work.

All the above branches of radiography require a dark room, somewhat similar to that of the photographer. One dark room will usually suffice for several radiographic rooms.

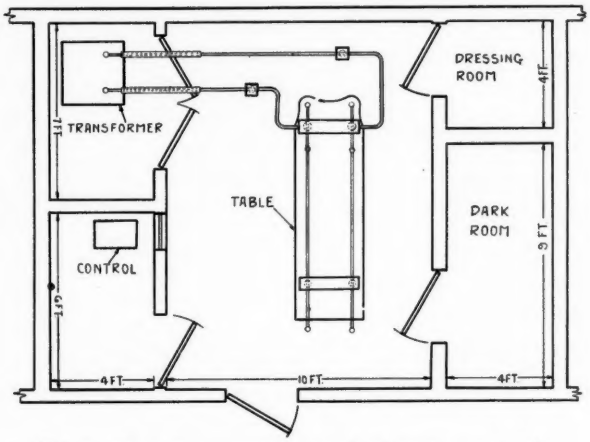

Fig. 2. General-purpose X-ray unit of medium capacity.

The fluoroscopic rooms have their own tables and other devices, and, while no dark room is needed, a toilet is a necessary adjunct.

Deep therapy requires its own equipment —a plain room for therapy table and accessories, a nearby compartment for X-ray machine, and another for the operator's control booth. The room containing the table is to be lined with sheet lead or its equivalent. No toilet or dark rooms are needed. In some instances another metabolism room or a small bedroom is provided.

Superficial therapy can usually be done with the average radiographic equipment. Only in case there is so much work of one class or the other as to interfere, are a separate room and facilities required.

While each of the above classes is definite and in large institutions complete in itself, small hospitals may, for economical reasons, effect certain combinations without detracting from efficiency. For instance, radiography and therapy can be performed on the same machine, but with different rooms and tables. Radiography and fluoroscopy are

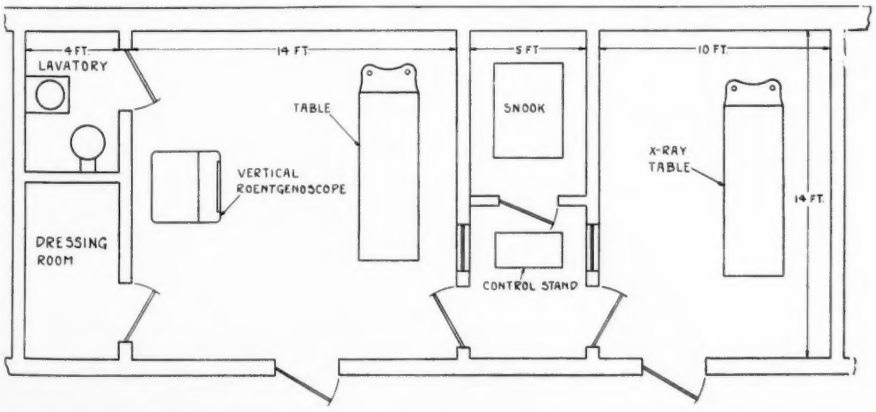

Fig. 3. X-ray unit (less dark room) with specialized fluoroscopic and radiographic rooms.

very commonly done on the same equipment, while therapy and fluoroscopy are practically never associated.

The possibility of the dual rôle apparatus is intimately connected with the other determining factor as to the amount of equipment, that is, the number of beds. In a comparatively small hospital, where the X-ray work is mostly diagnostic (radiography and fluoroscopy), a single transformer unit may suffice, and in many instances one of medium capacity. On the other hand, a large number of patients passing through the X-ray department of a large institution will necessitate the installation of several X-ray units, with the necessary accessories. It is, therefore, apparent that no fixed rule can apply in all cases and it behooves the hospital officials to consult their roentgenologist in this respect and especially consider the facilities which have been provided for institutions similar to their own, both in size and character of work.

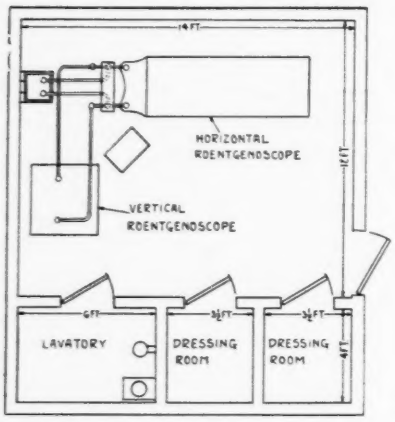

Fig. 4. Fluoroscopic room for large volume of work.

SPACE REQUIRED

The amount of space necessary can be determined only after selection of the essential equipment, as outlined in the foregoing. This may be from one or two rooms in small institutions, up to as many as eight or ten rooms in some of the large institutions, all depending, of course, on the volume of work to be handled daily and its

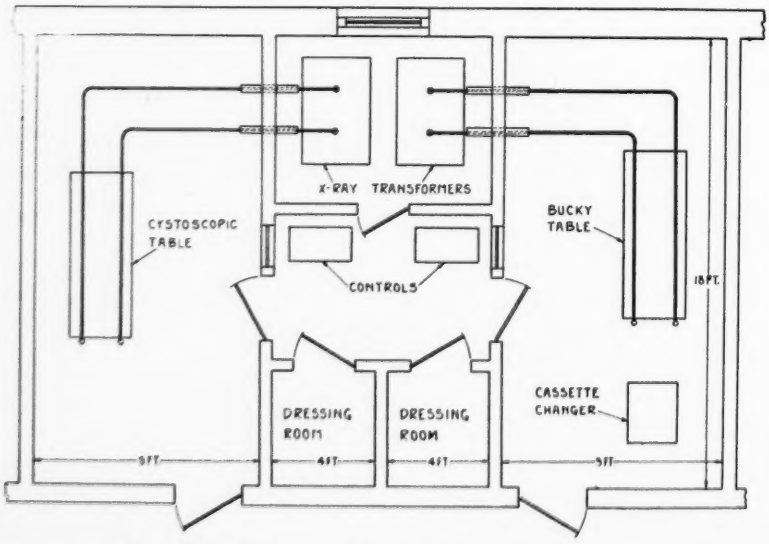

Fig. 5. Special radiographic unit for large volume of work.

nature. But regardless of whether it is one room or ten rooms, a most important factor to bear in mind is the minimum space in which the operator can work safely and efficiently. Most rooms should be large

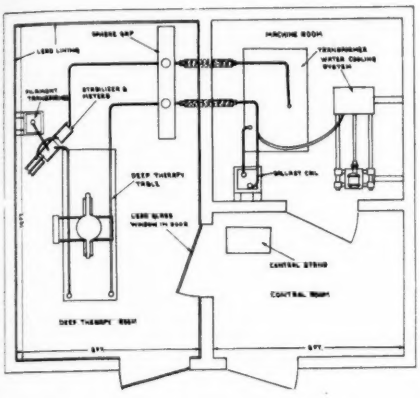

Fig. 6. Special unit for deep X-ray therapy.

enough to accommodate the special X-ray table and at the same time allow for a hospital cart to be wheeled in and turned completely around. This has also to do with the safety factor for both the operator and patient.

The present practice is to locate the X-ray machine in a small, ventilated compartment or closet off the working room. This keeps the machine cleaner and prolongs its life, and also eliminates operation noises, which might affect unusually nervous patients. A similar enclosed space is frequently desired for the operator's control booth; alcoves, closets, and ends of hallways can be advantageously used for these purposes.

LOCATION OF THE X-RAY DEPARTMENT

Investigation shows that in altogether too many instances it has been the practice to locate the X-ray department in the hospital basement. This probably resulted from the fact that the hospital was in operation and all space occupied before the need of the X-ray department was determined. It may have been due to the desire to avoid the noise of the equipment as designed in former years, but no longer a factor with modern apparatus. The many objections to a basement installation should remove all doubt as to its unsuitabilty. Some of the most important are as follows:

1. Dampness, causing deterioration of insulation and of cabinet work. Records show that the life of the apparatus has been reduced from 15 to 50 per cent by basement location.

2. Low ceilings, generally cluttered with a multitude of water, steam, and gas pipes and possibly some girders, all of which interfere with proper installation of high tension overhead.

3. Poor ventilation, with a consequent difficulty of eliminating the nitrous oxide fumes given off by X-ray apparatus not equipped with coronaless overhead.

4. Inconvenient to operating rooms and wards.

The space allotted to the X-ray department should be as convenient to the operating room as possible. This arrangement is appreciated especially in handling emergency cases.

The location of the X-ray department is also to a certain extent influenced by the character of the work to be done. For instance, it is usual to line the walls of the treatment room with sheet lead; good ventilation is also desirable. Therefore, if a corner room on the top floor is available for this, the ceiling and one or more walls can often be left unlined, effecting a material saving. Of course, whether or not this is done will depend upon the proximity of other buildings to the treatment room. Where the therapy apparatus is not used for other purposes, jurisdictional and operative personnel constitute the only reasons that

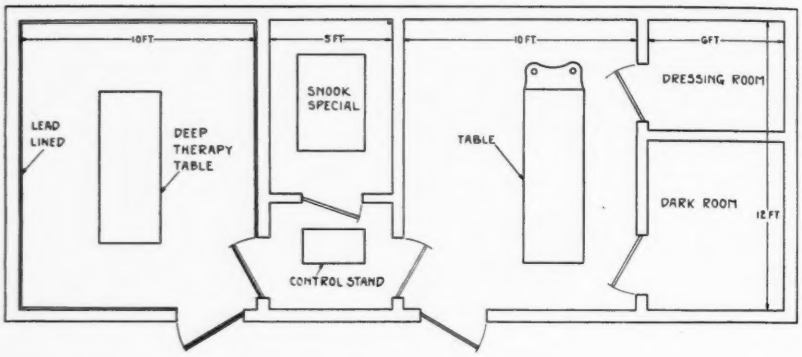

Fig. 7. Combined deep therapy and radiographic units using one X-ray machine.

might prevent its location away from the other X-ray apparatus.

Fluoroscopy, on the other hand, is performed in a darkened room, hence, an inside room or one with but few windows is desirable, provided proper ventilation can be assured without admitting light.

The dark room, which is a radiographic essential and should be near, has hot and cold water and a drain. Some economy can be effected by locating it close to toilets and lavatories. A location close to the therapy room is to be avoided unless this dark room is adequately protected by a sheet lead lining or its equivalent. A satisfactory arrangement where radiography and fluoroscopy are closely associated is to put the dark room and the toilet for the fluoroscopic rooms adjoining.

Some of the larger institutions doing a great volume of radiography have a film storage vault near or a part of the dark room. This is but a dry closet of suitable size and adequately protected from the X-ray by sheet lead or its equivalent.

THE SAFETY FACTOR

(a) High Tension.—The various units of the equipment should be so spaced as to offer the utmost possible protection against the high tension system to the operator, patient, and others present. With this necessary space allowed there can be no reason for an installation which unduly exposes an individual to shock from high tension current, as space is the best protection.

(b) X-ray.—The importance of X-ray protection to the operator, who is subject to daily radiation, cannot be overestimated, and in present-day installations it is noticeable that this factor is given prominence. While the importance of X-ray protection is universally conceded, opinions differ as to what is adequate. It has been general practice to leave this question, connected as it is with the possibility of injury to the human body, to the physician or trained roentgenologist. A very good discussion of this problem may be found in the November, 1925, issue of RADIOLOGY. The author, Mr. E. C. Jerman, writes with the authority of over twenty-five years' experience with all phases of radiographic work. The best the manufacturer can do is state the general practice and to give the relative values of the various protective materials. By taking full advantage of the materials available, the protection can be made sufficient for the most conservative. If this is done, any injurious effects which the operator may suffer can be due only to his own carelessness.

The usual protection consists of, first, a lead glass bowl enclosing the X-ray tube;

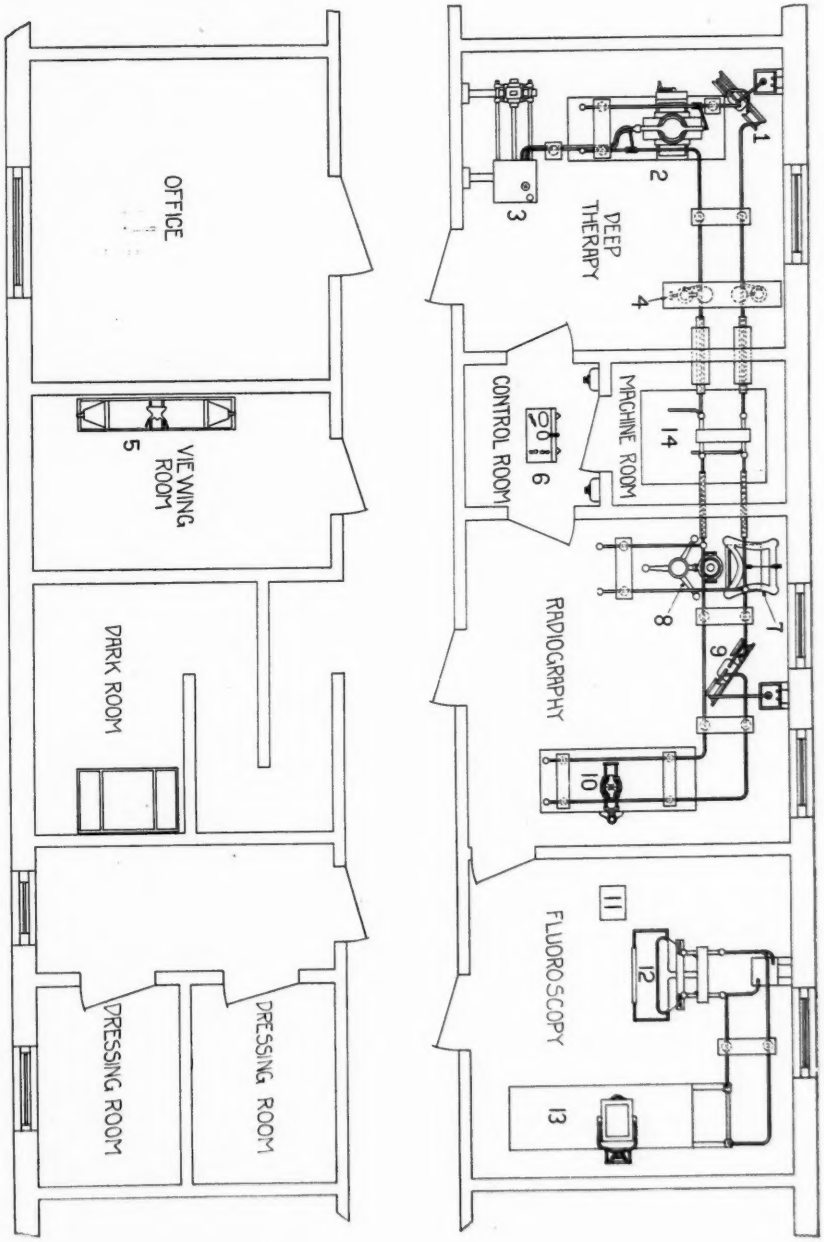

Fig. 8. Complete X-ray installation for large institution.

then, in addition, a certain amount of sheet lead on the walls of the room or booth. For therapy, the lead lining is universally required, but for radiography the amount of protection depends a great deal on the amount and character of the work.

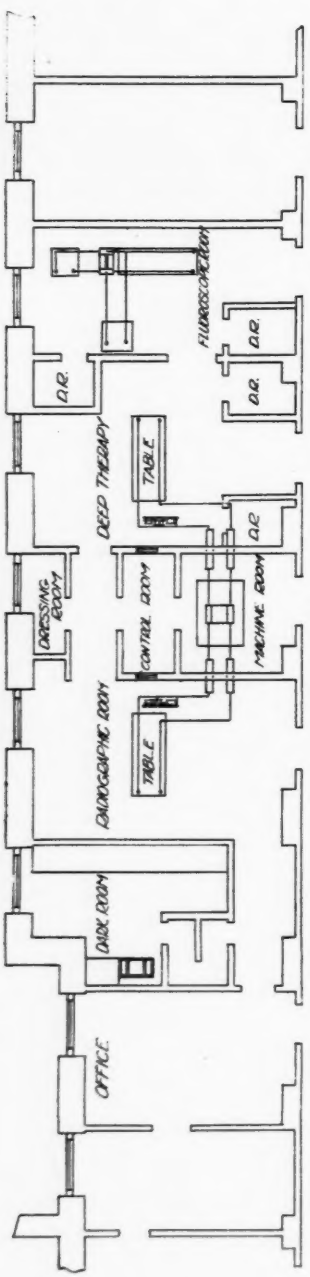

Fig. 9. Department of a hospital of medium size, as installed. Compare with Figure 10, in which certain features (see text) have been remedied.

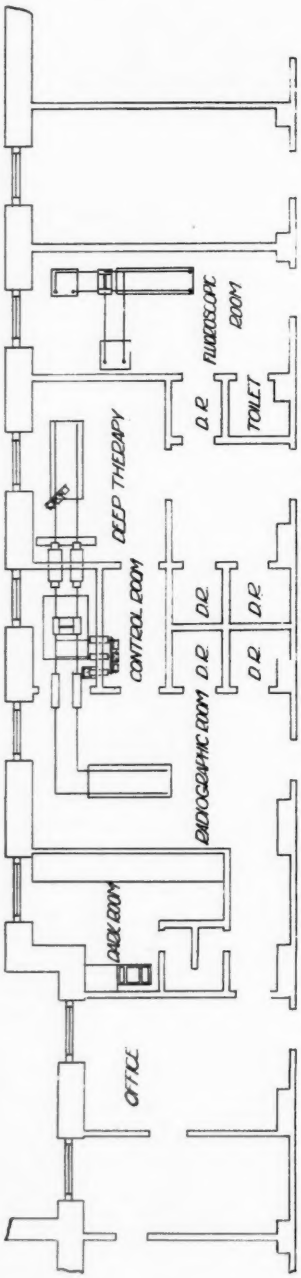

Fig. 10. The remodeled department—compare with Figure 9.

PRACTICAL INSTALLATION ARRANGEMENTS

There can, of course, be no one complete plan that will be suitable for the needs of all hospitals, but the majority of installations, regardless of their size, may be considered as combinations of rooms or units.

Each of these can be practically standardized, thereby offering a standard, though flexible, method of meeting the needs of all departments, if considered by the architect at a sufficiently early stage in the planning of the hospital.

The practicability of the above idea of X-ray department arrangement through the use of various standardized rooms or units will be discussed and demonstrated. In this discussion the plans utilized are those of successfully operating installations and the range covered is from that of a small installation to the department for some of the largest hospitals in the United States.

The various units and the work performed in them are as follows: Radiography, fluoroscopy, deep therapy (only in larger clinics, departments, or private offices), dark room, toilets, dressing rooms, film viewing and storage, office for roentgenologist, waiting room, and film vault. The last three will probably be found only in the larger institutions.

In many small installations the functions of several units are combined into one in order to reduce space requirements and cost. Such a unit is shown in Figure 1. It constitutes a radiographic and fluoroscopic unit, dark room, toilet, lavatory, and dressing room. This unit is suitable for either horizontal or vertical fluoroscopy and limited radiography, using for both purposes a combination table with a tilting top.

An installation using a larger machine is shown in Figure 2 and the main difference in the layout is the addition of a machine room and a control booth. The dressing room is also used as a toilet and a lavatory.

The layout of Figure 1, being of limited radiographic scope, may be considered as a primary fluoroscopic unit, while in Figure 2 the greater radiographic range possible makes it a basic radiographic unit.

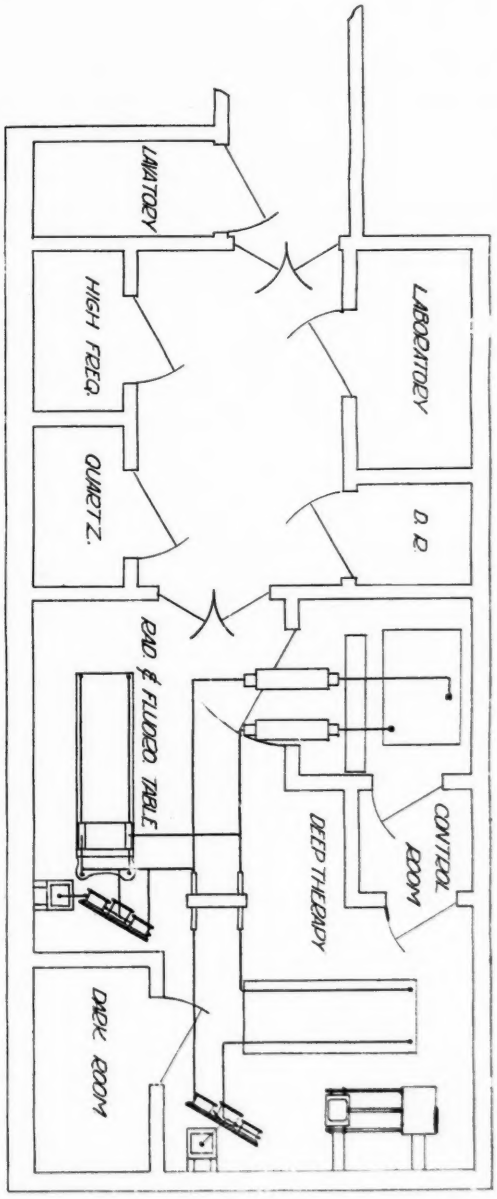

Fig. 11. The arrangement of apparatus in a private office, as installed.

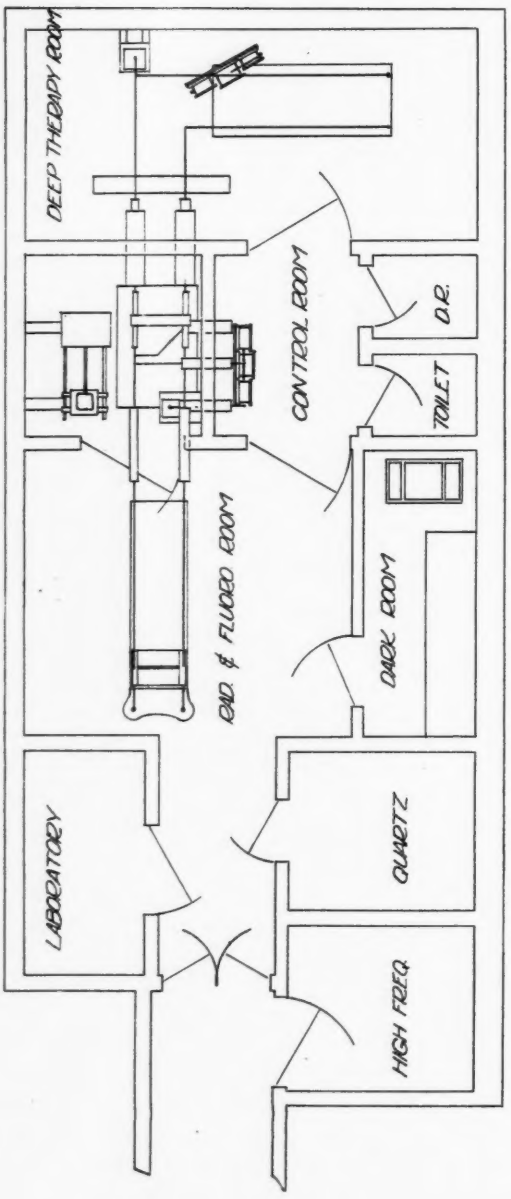

Fig. 12. Revised layout of office shown in Figure 11.

The next unit is a combination of Figures 1 and 2 and results in considerable saving of space and cost, because one machine is used for both rooms instead of there being separate machines. It is to be understood that to make the unit complete a dark room must be installed adjacent to the radiographic room. Additional dressing rooms may be added if necessary, when space permits.

Since it takes a certain amount of time to place a patient in position for either fluoroscopy or radiography, the X-ray machine is idle during this time. By alternating the placing of the patients it is entirely possible to operate two rooms from the same machine. This keeps the machine in operation a greater percentage of the time. A vertical and horizontal fluoroscope has been installed in the fluoroscopic room, thus avoiding tilting the table top. This combination may also be installed as a single unit, as shown in Figure 4.

If there is a sufficient amount of fluoroscopic work, it is possible to arrange a unit as in Figure 3, one room for vertical and the other for horizontal fluoroscopy. This is seldom necessary except in the largest hospitals. Also in the larger hospitals it is possible that there may be sufficient radiographic work to require a double radiographic unit, as shown in Figure 5. These radiographic rooms may each have specialized function, as, one for extremities or for chests, another for cystoscopic work. The therapy unit is generally complete in itself, as shown in Figure 6.

With the increased use of water-cooled tubes it is necessary to provide space for the water-cooling equipment, as shown by dotted lines. A better arrangement is to install the water-cooling equipment in the machine room, so as to reduce noise in the therapy room itself.

Therapy and radiography are often com-

bined to operate from a single machine, and, since radiography predominates in X-ray work, Figures 3 and 7 may be combined successfully. This will permit an extensive amount of work and is very satisfactory for large hospitals.

Now that all the units and their variations have been considered, they may be arranged in different combinations to meet the needs of any hospital. The layout as shown in Figure 8 is one that has been installed in one of the large hospitals and is a combination of standardized units. Some of the smaller units are not shown, but can be readily added.

The following layouts are typical arrangements of X-ray equipment in private offices and hospitals. Several of these layouts have been revised and changed in an attempt to improve the accessibility and operating conditions of the installation. The efficiency and operating conditions of many X-ray offices and departments may be changed materially by making only a few changes in the arrangement of the X-ray equipment and rooms.

Figure 9 shows the arrangement of X-ray equipment in the department of a medium size hospital, now in operation. Considerable space has been taken up by installing dressing rooms in the corners of the deep therapy and fluoroscopic rooms. These odd shaped rooms result in considerable space being unusable. With but one dressing room convenient to the radiographic room, there may be considerable time lost while patients wait, or, if the use of the other dressing rooms is attempted, it may interfere with the therapy work. The dressing rooms should be kept as near the corridor as possible, so as to limit the number of persons passing the X-ray equipment unnecessarily. The arrangement of dressing rooms as shown in the revised layout of Figure 2 eliminates the aforementioned difficulties.

Since all deep therapy rooms should be lined with lead or its equivalent, it is necessary to keep the size and shape of the room small and regular so as to reduce the cost of lining it. The deep therapy room in Figure 9 is entirely too large and very irregular in shape. These conditions have been remedied in Figure 10 by reducing its size and making it of a more regular shape. The machine room of Figure 9 is larger than necessary and, since it is entered only when repairs or adjustments of equipment are necessary, it should be placed next to the outside wall rather than the corridor. It is also important to have the machine room well ventilated and this necessitates an outside room being used. The passageway between the radiographic and the deep therapy rooms of Figure 9 has been taken care of in Figure 10, by allowing ample space for the passage of hospital carts through the control room. The dark room and office have not been changed.

Figure 11 shows the arrangement of apparatus in a private office as installed. As a result, the arrangement indicates that very little thought was used in the design and placing of the equipment. There is no protection from the deep therapy X-rays, and, due to the large size of the room, the cost of installing protective equipment is prohibitive. The stabilizer and meters, which should be near the control room, are located at the opposite side of the room. The water-cooling equipment, which makes considerable noise when in operation, is above the deep therapy table and may result in considerable annoyance to patients. The toilet, which is a necessary part of the fluoroscopic room, is not easily accessible. The two rooms for high frequency diathermy and quartz lamp treatments are so small that their use is practically impossible.

The revised layout of this office is shown in Figure 12. The errors in the design, as mentioned in the preceding paragraph,

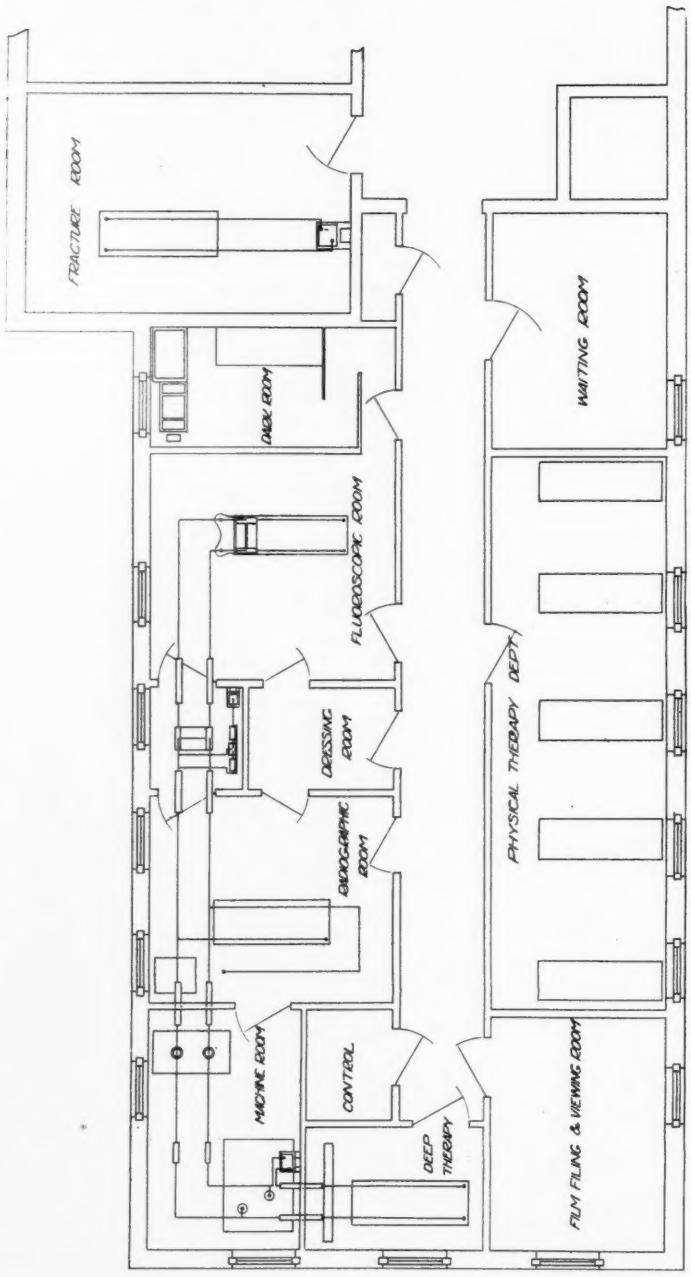

Fig. 13. A large hospital installation, which resulted in a lack of co-ordination between several of the units (see text).

have been corrected in the revised layout of equipment and rooms, without increasing the amount of floor space assigned.

A large hospital installation designed recently, as shown in Figure 13, resulted in a lack of co-ordination between several of the units. As far as the individual X-ray units were concerned, they were designed for

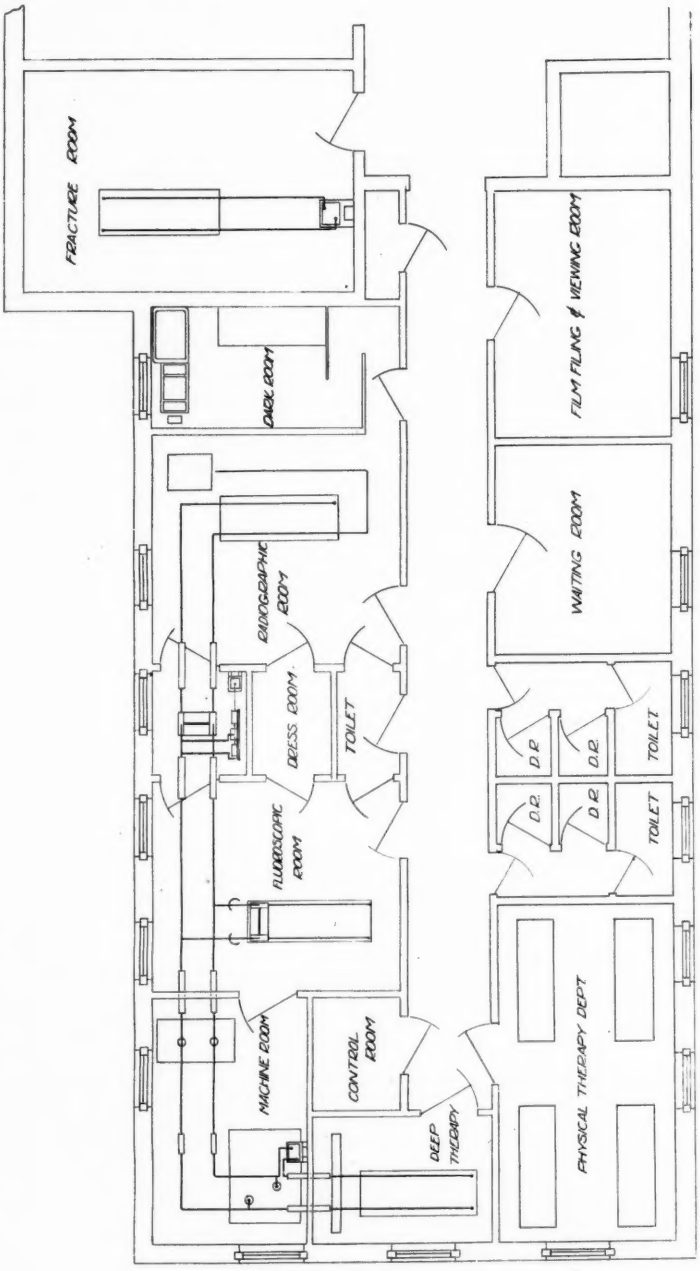

Fig. 14. The relocation of various units shown in Figure 13.

maximum efficiency. The conditions shown here may be remedied very easily by relocating several of the units, as will be explained.

The radiographic room should be placed near the dark room, also the film filing and viewing rooms should be made more accessible to the dark room. As laid out, there

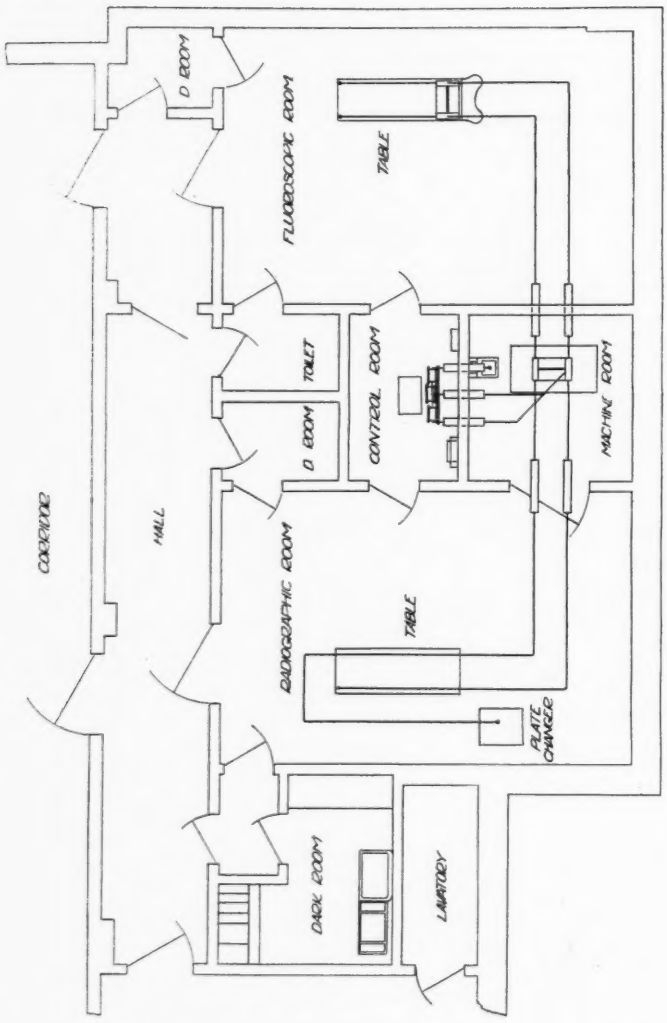

Fig. 15. A model private office installation.

will be considerable time lost transporting films between the rooms. For an installation of this size, considerably more space should be provided for dressing rooms, also a toilet should be provided as near the fluoroscopic room as possible.

The various units have been re-located in a new design and are shown in Figure 14. The radiographic and fluoroscopic rooms have been interchanged so that the radiographic room is adjacent to the dark room. The film filing and viewing room was moved so as to be as near the dark room as possible. The one dressing room was divided so as to provide space for a toilet and a dressing room. The size of the physical therapy department was reduced in order to provide additional space for dressing rooms. The two X-ray machines have been placed in one machine room and are inter-connected so that in case one machine breaks down, the three X-ray rooms may be operated from the other machine.

Figure 15 is a design of an installation

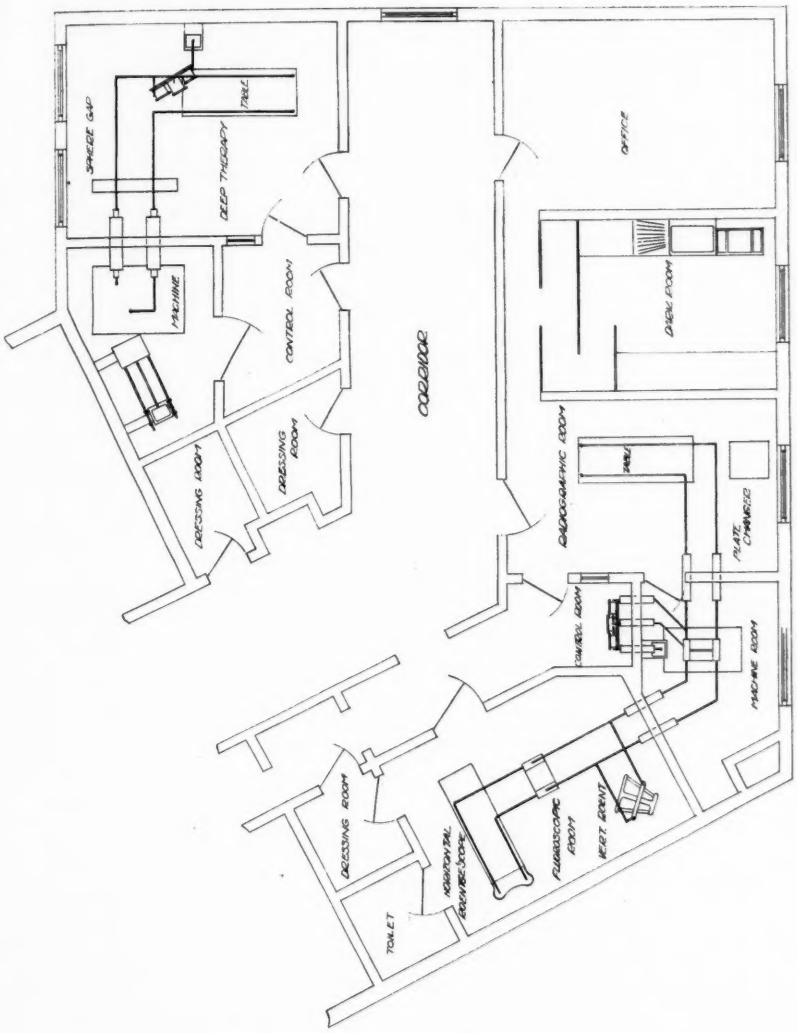

Fig. 16. An excellent hospital department, though of irregular shape.

made in a private office a short time ago. This office was designed according to the principles brought forward in the preceding paragraphs and is, therefore, a model installation. A further explanation of its operating efficiency and accessibility is not necessary.

Figure 16 shows the possibilities of arranging the units and equipment so as to form an excellent hospital department, even if the space allotted is of odd shape. This department, again, has been designed according to the unit idea, as already explained in this article.

THE EFFECTS OF CARBON ARC RADIATION ON THE BLOOD AND CIRCULATORY SYSTEM[1]

By HENRY LAURENS, PH.D., Laboratory of Physiology, Tulane University School of Medicine, NEW ORLEANS, LOUISIANA

IT HAS been established that light treatment is excellent for surgical tuberculosis and rickets, and the effects on many other diseases show that we have in this therapeutic measure a stimulant to general health. Skin diseases, chronic anemias, nutritional weakness and wasting in infants, chronic bronchitis, the debility following acute infectious disease, etc., are greatly benefited and the healing of refractory wounds of all sorts is accelerated.

There is a lack of appreciation on the part of many as to what radiation embodies, of how the radiation of the quartz Hg lamp and of the C arc differ from that of the sun, of the importance of the intensity and duration of energy—its dosage. We can not always depend on the sun and so must have recourse to artificial sources.

It should be obvious that if we are trying to copy sunlight we should know something about it as well as about the energy emitted by artificial sources. There is a common belief that the radiation of such sources is solely or mainly active because of the ultra-violet fraction. This has been demonstrated in but few instances, such as the treatment and prevention of rickets, and the formation of melanin in the skin. On the other hand, there is much evidence that the effects observed are due to the entire spectrum (Lo Grasso, Balderrey and Ewald). In some cases the evidence points to the visible portion as being particularly active (Sonne, Loewy and Dorno). In still others the action of certain wave lengths in the ultra-violet has been shown to be increased by the simultaneous action of the visible and infra-red. The appreciation of this activation, or intensification of the action, of ultra-violet by visible and heat rays is demonstrated on the Continent by the placing of a cluster of incandescent lamps around the hood of the quartz Hg vapor lamp.

Comparison between sources shows the importance of specifying the percentage distribution of the energy emitted. Air-cooled quartz Hg lamps have a percentage distribution about as follows: 30 per cent ultra-violet, 53 per cent visible, and 17 per cent infra-red. In the water-cooled lamps the ultra-violet equals the visible. The energy of a 28 amp., 60 to 65 volt, flaming C arc is 15 per cent ultra-violet, 59 per cent visible, and 26 per cent infra-red. Sunlight at sea level contains from 1 to 4 per cent (usually not more than 1 per cent) ultra-violet, 42 to 53 per cent visible, and 57 to 43 per cent infra-red. Sunlight on Mount Wilson (1750 M.) contains from 2 to 5 per cent ultra-violet, 50 to 55 per cent visible, and 48 to 40 per cent infra-red; on Mount Whitney (4420 M.), 2 to 6 per cent ultra-violet, 54 to 55 per cent visible, and 43 to 39 per cent infra-red. The line spectrum of Hg vapor lamps extends to between 185 and 200 mμ, that of a flaming C arc to 218 mμ, though most of the energy is at wave lengths longer than 290 mμ. The sun's spectrum at noon may extend to nearly 290 mμ, but there is little energy below 300 mμ, and smoke and water vapor cut out much between this and 320 mμ.

We measure not only the C arc radiation which we use, but sunlight as well, photographing the spectrum to determine the shortest waves emitted according to season and determining the total energy and its spectral distribution by means of a pyrheliometer. There are numerous reasons for

[1]Read at the Thirteenth Annual Meeting of the Radiological Society of North America, November 29, 1927, at New Orleans, Louisiana.

preferring the C arc to the Hg lamp. As in the case of the sun, the action of the ultra-violet is activated by the luminous and heat rays. The Hg lamp is proportionately high in ultra-violet but emits much fewer heat and visible rays, and the short rays, in spite of their intense surface action, have poor penetrating power. The rays of the C arc penetrate farther. The C arc produces a strong red-brown pigmentation in contrast to the pale, slaty, yellowish-red produced by the Hg lamp. As Sonne points out, while we are certain that in rickets and tetany it is the ultra-violet portion of the energy which is of benefit, this is not the case in tuberculosis, there being a strong likelihood that it is the combination of visible, ultra-violet, and infra-red which is beneficial. Mayer, however, believes that the only basis for the insistence by some on a source of radiation having a spectrum closely resembling that of sunlight is that results with solar exposure have been most favorable in the hands of these workers. He holds that there are sufficient grounds for expecting therapeutic results with other combinations of light rays, certain forms of tuberculosis responding more readily to sources of great intensity in ultra-violet radiation than to solar radiation.

There is a more or less general view that irradiation produces a greater or less drop in blood pressure. The factors held responsible are diverse, namely, cutaneous hyperemia, changes in blood viscosity, production and setting free of depressor substances, the breathing of nitrous oxide, and sympathetic hypotonia. The pulse after irradiation is usually found to be slower, fuller, and stronger, a reaction which Koenigsfeld, however, ascribes in part to the rest during the period of irradiation. Although many have demonstrated decreases in blood pressure, in the hands of some irradiation has produced either no effect or has been attended by an increase in pressure.

That irradiation produces a greater or less drop in blood pressure has been experimentally substantiated in my laboratory. We have studied the blood pressure, pulse rate, and body temperature of normal dogs. Following moderate (55 g. cal. per sq. cm.) abdominal irradiation, decreases of between 15 and 20 per cent in systolic pressure and of 10 per cent in diastolic pressure occur after the fourth or fifth exposure to a C arc, and re-occur following subsequent exposures, the normal values being usually regained within 24 hours after each exposure. More marked and permanent effects are obtained following massive (83 to 166 g. cal. per sq. cm.) irradiations at intervals of 2, 3, and 6 days, respectively. After the fourth exposure, the levels of both systolic and diastolic pressures remain low for over a week and then slowly rise to normal, which they reach on about the twentieth day. The pulse rate usually increases, an average of 20 per cent, during irradiation, but returns to normal soon after. Body temperature increases during irradiation by not more than a degree and soon returns to normal. The effects are not due to the inhalation of fumes. The pressure readings are taken by auscultation of the femoral artery.

Comment is frequently made on the pale, anemic appearance of those working and living in poorly lighted rooms, but it does not necessarily follow that there is in these cases a change in blood constitution, for it is not the hemoglobin content or the absolute number of red cells which is decreased by lack of light, but the volume of blood going to the skin. Light, within physiological limits, widens the cutaneous vessels and thereby allows more blood to go to the skin. It is possible that during a lasting deprivation of light the skin vessels may become constricted and the skin thus assume a bloodless appearance. Such anemic look-

ing persons often have a surprisingly high hemoglobin content.

Bernhard, on the other hand, is convinced of the harmful effects of the lack of light as exemplified in what he calls the anemic condition of those in the Alps who live on the shady side of the deep valleys, as contrasted with those who dwell where they are reached by the sun's rays. Similar effects, he claims, are reported by many polar investigators, namely, that the Eskimos and members of the expeditions are, at the end of the long polar night, anemic, edematous, and weak. Bernhard believes that the reason why no changes are reported as occurring in the blood of the members of the polar expeditions is the fact that the winters are spent in illuminated ships and that the failure to find evidences of anemia in mine horses is due to the fact that the mines are artificially illuminated. Recent observations on mules kept in almost always dark mines between five and ten years show but a slight increase in red cells and a corresponding decrease in hemoglobin. The increase in red cells is probably due to the good and abundant diet and the hard work that the animals do—an increased metabolism, thus representing an over-compensation against any possible deleterious influence that the lack of sunlight may have.

Many of the observations on the blood picture during and following irradiation have been made under the most diverse conditions, at high altitude, in the tropics, at sea level, inland and on the shore; following irradiation with the sun, the quartz Hg lamp, and the C arc; on the well, the sick, on children, and on adults. It is no wonder that the most diverse results have been reported. Ultra-violet rays are apparently ineffective in pernicious anemia, but effectual in secondary anemia of moderate intensity, and the anemias of rickets, syphilis, malnutrition, and hemorrhage may benefit, while that of tuberculosis does not.

We are now working on the influence of C arc radiation on the blood of normal and anemic dogs. Animals are exposed daily, or at short intervals, to moderate or massive doses. The primary effect is dilution of the blood due to an increase, depending on the strength of the exposure, of 20 to 40 per cent in plasma volume. With repeated doses this dilution is usually followed by a secondary concentration. These volume changes are usually accompanied or followed by an increase in red cell number and hemoglobin varying from 5 to 20 per cent. Massive exposures cause blood destruction, fragments and cells of irregular shape and small size making their appearance. When moderate exposures are given at intervals the increase in red cells is maintained at a level about 15 per cent above normal for from 4 to 6 weeks after the last irradiation. The cells during the post-irradiation period are smaller in size and usually of normal saturation. Post-irradiation rises in platelets are frequent. Leukocytes usually decrease, in some experiments showing a maximum post-irradiation decrease of 50 per cent.

We have conducted a few experiments on the effect of C arc radiation in anemia produced by hemorrhage. Dogs are bled and irradiated three times a week with a moderate dosage (30 g. cal. per sq. cm.) until normal levels are reached. The response of the red cells in the irradiated animals in each case is quicker and greater than in the controls. In one dog the red cell number and volume were 87 per cent normal in 13 days; in another, complete recovery was obtained in 22 days, as compared with 26 and 27 days, respectively, in the controls.

DISCUSSION

DR. R. H. STEVENS (Detroit): I want to congratulate the Society on having the privilege of listening to this paper, which I

think is one of the most complete on light treatment, one of the most illuminating I have listened to in some time—and we have had some very good papers presented before this Society, which have given us a good deal of knowledge upon this subject of light radiation. I was glad to hear the author emphasize the difference between the ultra-violet radiation and radiation from the carbon arc light, and the values of the two as learned from laboratory and clinical experience, because there is so much misconception about radiation with the ultra-violet ray, and also the question of dosage. A great deal of good may be done by moderate dosage, but great harm may be done, even to the extent perhaps of producing death, by too heavy a dosage.

That brings up the point that we need here something, just as we do in X-ray work, to measure more accurately the dosage of radiation by means of the various forms of light. Dr. Pohle, of the University of Michigan, has recently constructed an instrument along that line, which I hope will prove to be of considerable value to us.

Regarding the Transfer of the Roentgen-ray Dose. M. Jona. Strahlentherapie, 1927, XXVI, 614.

The Wulf Ionometer is, according to the experience of the author, constant and reliable enough over a period of a year to permit of its use for calibrating a roentgen apparatus in roentgen units.

E. A. POHLE, M.D.

X-ray Diagnosis of Anencephalus. Bernard R. Mooney. Can. Med. Assn. Jour., September, 1927, XVII, 1053.

The X-ray is not called to the assistance of the obstetrician as often as it should be. One reason for its non-use is the fear of danger to the fetus. This, however, is an unfounded fear, as there is no danger to the fetus in the exposure necessary to secure diagnostic films.

Two case reports are given to show how convenient the X-ray is in making the diagnosis of anencephalus before labor begins. Such diagnosis is difficult apart from the X-ray film. In this condition the recognition of the presenting part is difficult or impossible by the usual means.

In the interpretation of the films the striking feature is the absence of the cranial vault.

L. J. CARTER, M.D.

The Absolute Measurement of the Dose Unit One Roentgen in the Calibration Department of the Cleveland Clinic. Otto Glasser. Strahlentherapie, 1927, XXVII, 160.

Following the example of Behnken, the author describes his apparatus with which he carried out the absolute measurement of the roentgen unit.

E. A. POHLE, M.D.

LIVER MEASUREMENT

A COMPARATIVE STUDY ON THE RELATION OF CHRONIC GALL-BLADDER DISEASE TO THE SIZE OF THE LIVER[1]

By MAURICE FELDMAN, M.D., Associate in Gastro-enterology, University of Maryland, BALTIMORE

GREAT interest has been manifested in gall-bladder disease, especially since the advent of cholecystography, for this method of diagnosis has led to a far more accurate study of affections present in the upper right quadrant of the abdomen. In the roentgenographic examination of the gall bladder, the liver shadow is usually well outlined, though heretofore little attention has been paid to actual measurements. However, in the routine gastro-intestinal roentgen examination it is usually customary, whenever possible, to report the size of the liver as being normal, slightly enlarged, moderately enlarged, or markedly enlarged, together with a statement of the number of finger-breadths or centimeters of its position below the costal margin. Since these terms are only relative, it would seem far more satisfactory, as well as accurate, if the actual measurements could be determined.

In many instances the liver shadow is visualized more satisfactorily before than after the administration of tetraiodophenolphthalein; more frequently, however, the outline becomes clearer following the administration of the dye. On the other hand, the lower margin of the liver frequently shades off towards the kidney and other structures, thus making it difficult to secure proper measurements.

Pfahler (1), in a recent study of liver measurements, demonstrated the average length of the right lobe to be 21.3 cm. and the average thickness 12.8 cm. In attempting to standardize this method to determine the size of the liver the following technic has been used. The subject is placed in the supine position on the Potter-Bucky diaphragm and a 14 × 17 film taken, which includes both kidneys and spleen. Two measurements are secured: one, the "length," measured from the highest point of the upper border to the tip of the right lobe; the second measurement, "thickness," is measured from the upper to the lower border in an oblique direction.

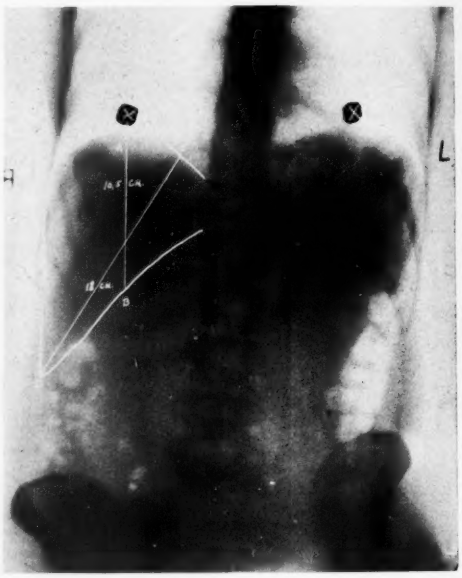

Fig. 1. Showing the liver outlined: (*a*)–(*b*) vertical measurement; (*c*)–(*d*) oblique measurement.

In our study an attempt is made to compare and correlate the size of the liver with regard to the gall-bladder pathology as determined by the gall-bladder visualization test.

[1]From the Gastro-enterological Clinic of the Department of Medicine, University of Maryland.

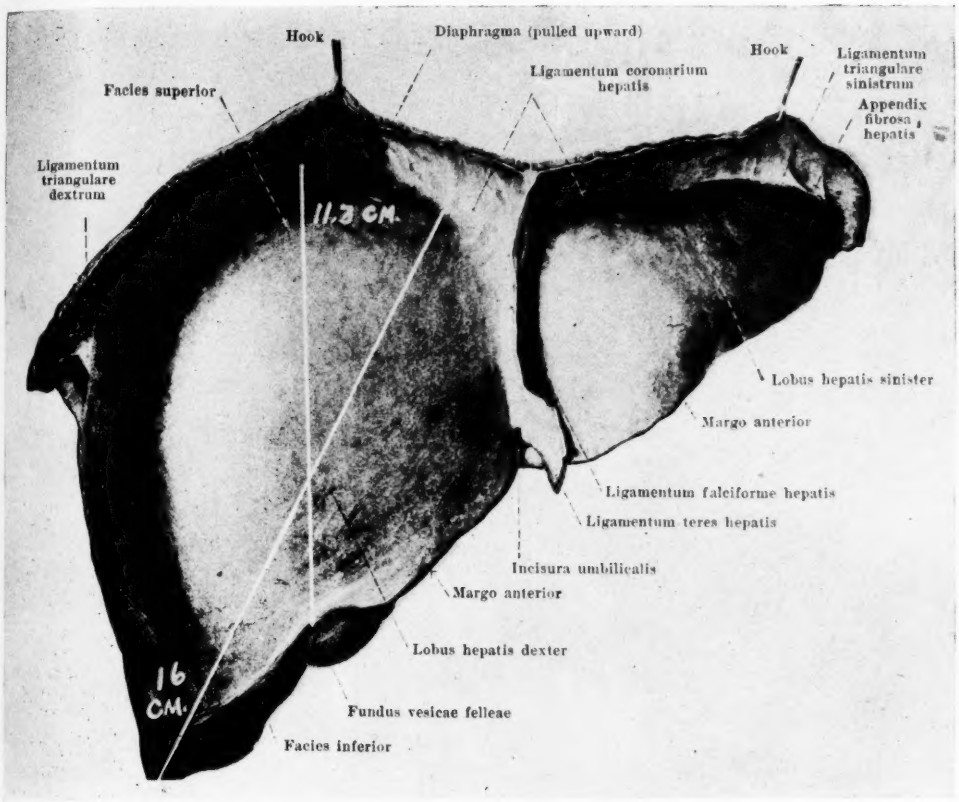

Fig. 2. Illustrating the measurement of the liver. (Photograph from Werner Spalteholz, enlarged.)

TECHNIC

The method followed is the usual gall-bladder technic, the patient lying on the abdomen on the Potter-Bucky diaphragm. A series of films is made of the gall bladder, which also includes the liver, a method which does not require an additional examination for liver measurement. The films are taken in both inspiration and expiration and movements of the liver, together with the diaphragm, are noted during respiration. This organ will be observed to be lower in deep inspiration and higher in deep expiration.

The measurement of the liver in this series is made from four fixed anatomical points, differing somewhat from that advocated by Pfahler. Only the right lobe of the liver is measured. The left lobe is not usually visualized, as it is overshadowed by other structures.

(1) Vertical measurement; from the upper to the lower border in the nipple line.

(2) Oblique measurement; from an angle made by the spine, liver, and diaphragm to the tip of the right lobe.

The measurements obtained in this series compare favorably with those obtained by Pfahler. By utilizing the vertical and oblique measurements, measuring from fixed anatomical points, there is less danger of

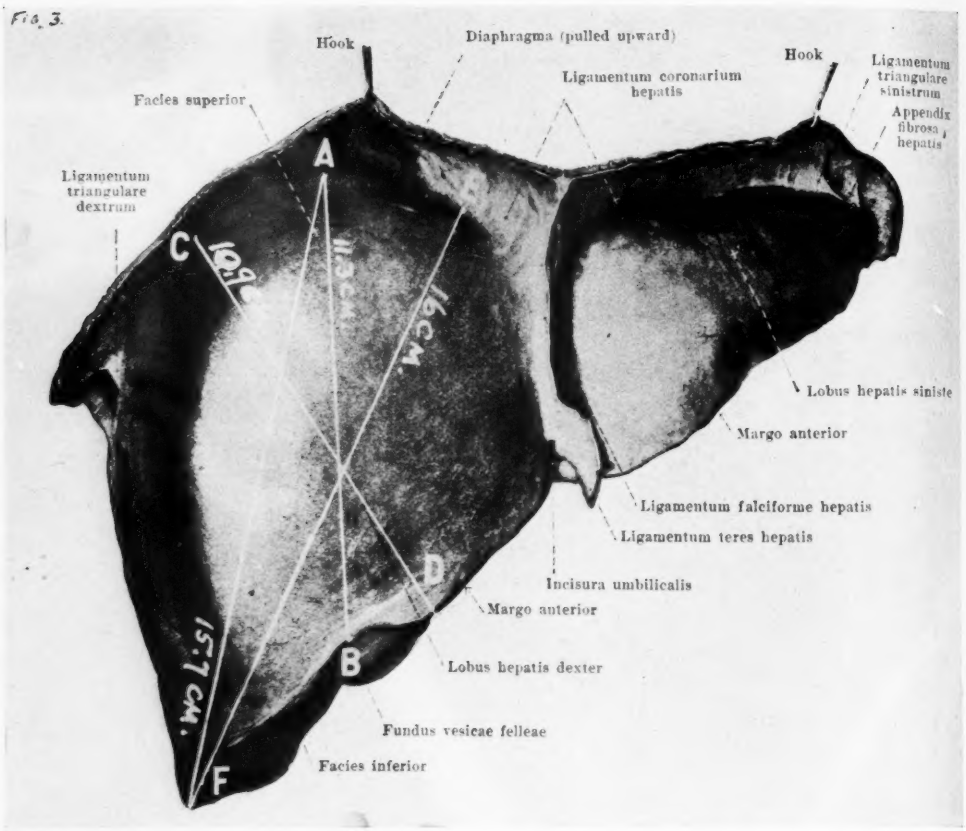

Fig. 3. Showing measurement of liver from six anatomical points. (Photograph from Werner Spalteholz, enlarged.)

error, the results being more constant and uniform.

In this series 250 cases of suspected gall-bladder disease were examined by the oral administration of tetraiodophenolphthalein. Of these, only 170 could be measured, while in 80 cases the liver shadow shaded off into other structures, making measurement impossible. This, however, was not due to faulty technic, but, rather, to a lessened density of the liver structure or to lack of air in the colon. Of the 170 cases examined, the gall bladder was found normal in 81 instances and diseased in 89. Of these, 21 of the abnormal and 5 of the normal cases came to operation and in all the diagnosis was confirmed.

The measurement of the entire series ranged from 9½ cm. to 20 cm. in the vertical position and 14½ cm. to 26 cm. in the oblique.

The measurement of the livers in the normal gall-bladder series ranged from 9½ cm. to 20 cm. in the vertical line and 16½ cm. to 26 cm. in the oblique.

In the abnormal gall-bladder series the liver measurement ranged from 8½ cm. to 19 cm. in the vertical line and 14½ cm. to 26 cm. in the oblique.

Moreover, as a result of these studies in

comparing the size of the livers in the normal and abnormal gall-bladder series, no actual changes or differences in the size of the liver as measured by this standard are observed. Chronic gall-bladder disease, therefore, does not influence the size of the liver, according to these observations.

It is also of interest to note that of the 170 cases examined for gall-bladder disease, in 97, routine gastro-intestinal roentgen examinations were made and in only two instances was the liver found to extend below the costal margin, while in 95 it was considered normal in size, the costal margin being taken as a normal fixed point. These results were obtained both from a study of the films and by fluoroscopic examinations.

Weight has practically no effect on the average size of the liver. While the livers of some individuals above the 175-pound group appeared larger than in the group of lesser weight, they all apparently fell in the average group, as shown above. The size of the liver is also apparently not influenced by age or sex.

CONCLUSIONS

1. Chronic gall-bladder disease produces no noticeable influence on the size of the liver.

2. The average vertical measurement ranges from 11 cm. to 15 cm.; the average oblique measurement from 18 cm. to 21 cm.

3. Four fixed anatomical points are utilized as a standard for measurement: (*a*) upper border to (*b*) lower border, in the nipple line; (*c*) angle made by the spine, liver, and diaphragm to (*d*) the tip of the right lobe.

REFERENCE

(1) PFAHLER, G. E.: The Measurement of the Liver by Means of Roentgen Rays, Based upon a Study of 502 Subjects. Am. Jour. Roentgenol. and Rad. Ther., December, 1926, XVI, 558.

ROENTGEN ANALYSIS OF BONE DISEASE[1]

By S. C. BARROW, M.D., SHREVEPORT, LOUISIANA

WHEN Roentgen made his epochal discovery and demonstrated the first radiograph made, the eyes and minds of the medical profession were centered on the shadows of the bones and the shown by the radiograph in terms of the different and varying densities resulting from different disease processes.

Of the many thousands of X-ray films made since that discovery it is safe to say

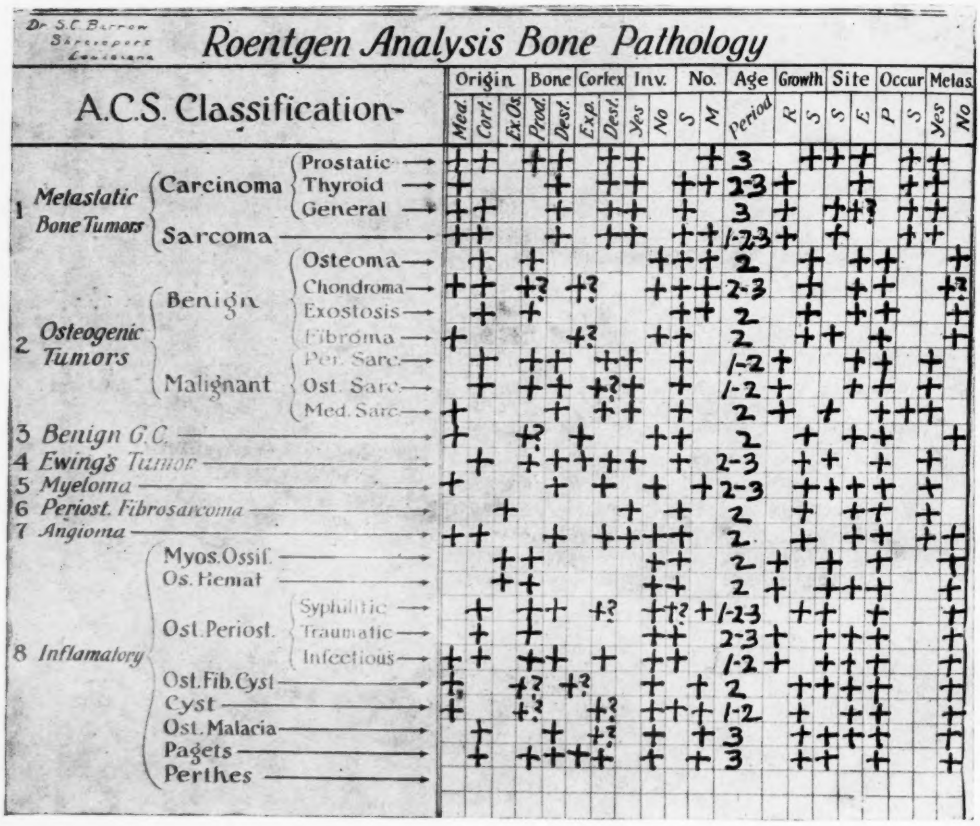

Fig. 1. Classification of bone pathology. (See Footnote 2 for explanation of abbreviations.)

thought dominant was, "Here we have a diagnostic agent for all conditions and diseases involving the bony anatomy." We did not see the necessity then, nor have many of us learned it yet, of carefully analyzing and systematizing the shadows as on each have appeared shadows of bone structure. No portion of the anatomy has been so constantly observed by means of the X-ray as has the bony structure, yet with

[1]Presented before the Radiological Society of North America at the Twelfth Annual Meeting, at Milwaukee, Dec. 3, 1926.

[2]Explanation of abbreviations employed in the charts: Med. (Medullary); Cort. (Cortical); Ex. Os. (Extra-osseous); Prod. (Production); Dest. (Destruction); Exp. (Expansion); Inv. (Invasion); No. S. (Number, single); No. M. (Number, multiple); Growth, R. (Growth, rapid); Growth, S. (Growth, slow); Site, S. (Site, shaft); Site, E. (Site, end); Occur, P. (Occur, plural); Occur, S. (Occur, single).

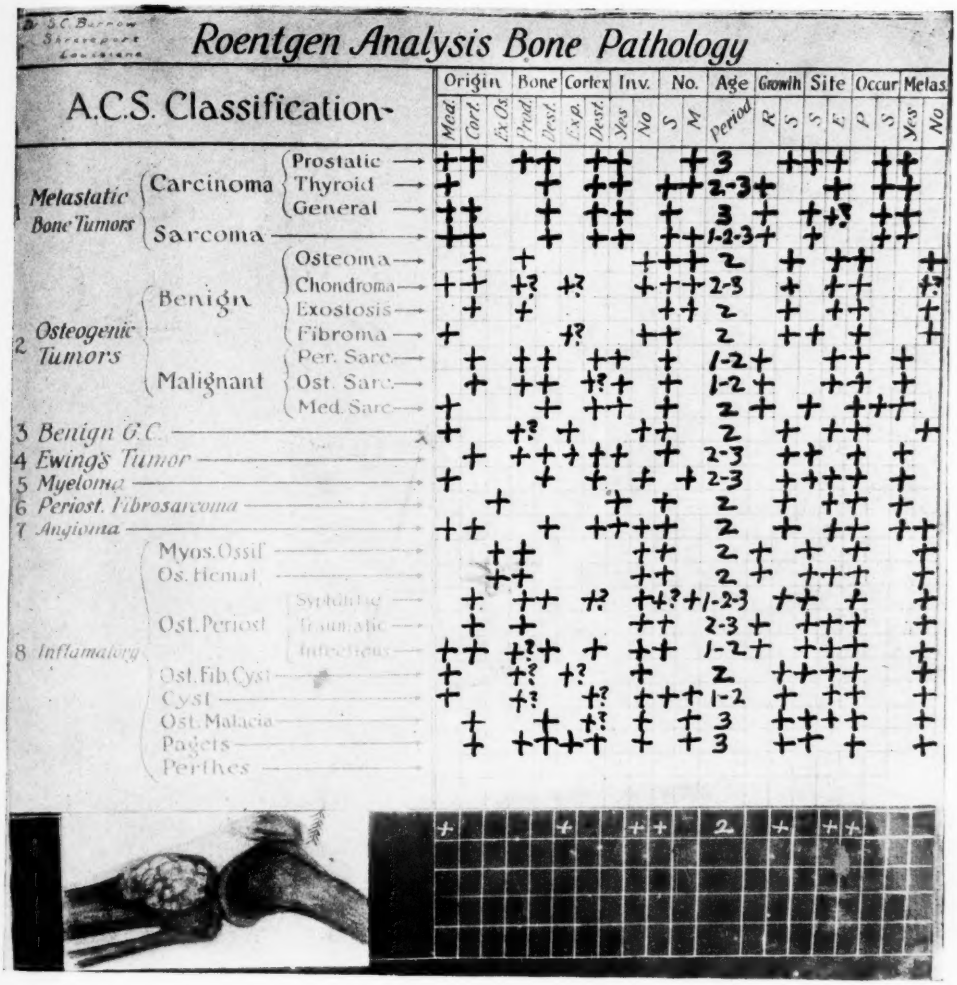

Fig. 2. Chart checked for giant cell tumor.

all this opportunity, with all this wealth of material, with all this forced experience, analysis of X-ray shadows of bone pathology lags to-day in comparison with the store of knowledge of other portions of the anatomy which have lent themselves to X-ray study. Because of its everyday occurrence, because of its simplicity, we have failed to take note of details revealed by X-ray study which, in the aggregate, properly analyzed, will usually reveal the true nature of the pathological process.

Our observation has been that most radiologists have no system of analysis in their interpretation of bone skiagraphs, their conclusions being drawn on first glance without a logical ruling out of other possibilities. In many instances the case is a sarcoma, a cyst, or what not, because it resembles the illustration in some text book.

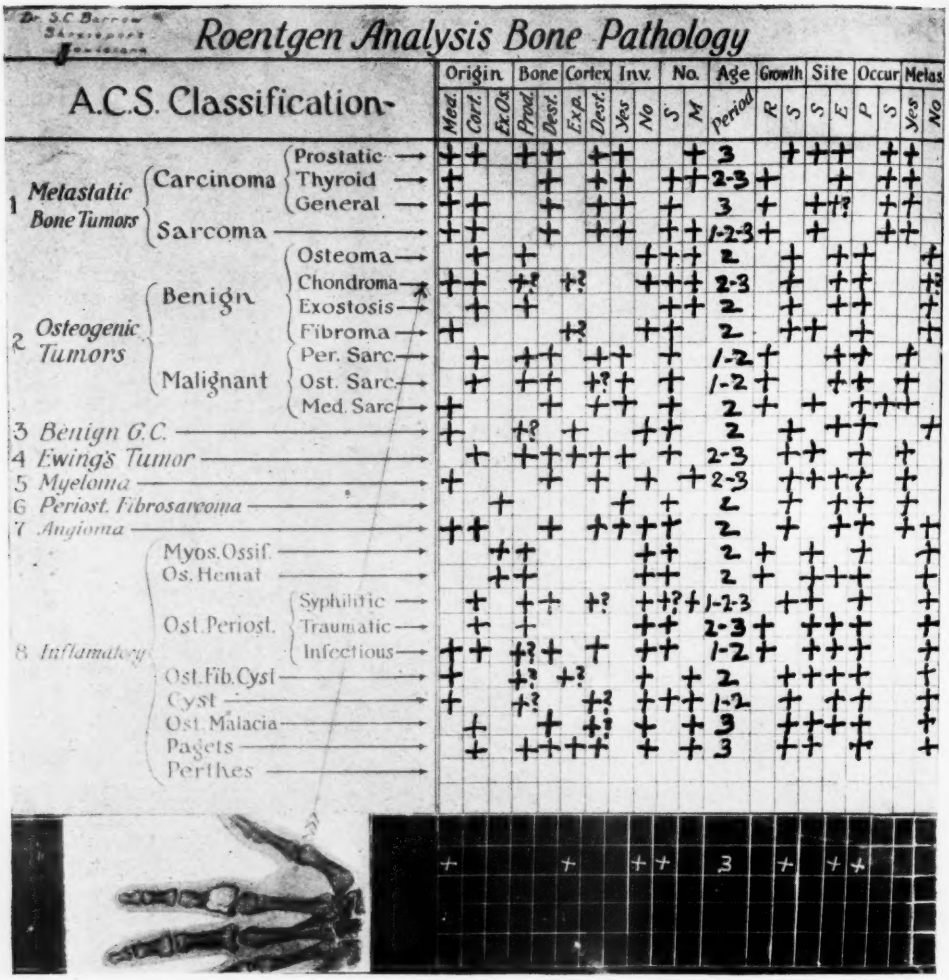

Fig. 3. Sample chart, showing method of checking: X-ray finding, chondroma.

Another practice strongly to be condemned in our opinion is the tendency to report on the clinical appearances rather than on X-ray shadows, though the report is supposed to be an X-ray report. The fields of clinical medicine and radiology are entirely too large to be mastered by one mind. X-ray observations interpreted with a clinical picture in mind or clinical examinations after an X-ray observation, are usually biased and are not logical conclusions in either instance, but rather hybrids running true to neither.

I believe the X-ray shadows should be interpreted and a conclusion drawn as nearly as possible independent of clinical data. My greatest blunders have been made where I had been told in detail the clinical symptoms. In passing, we would suggest to the clinician to follow the same course.

On investigating the cause of our failures to properly interpret films of bone disease.

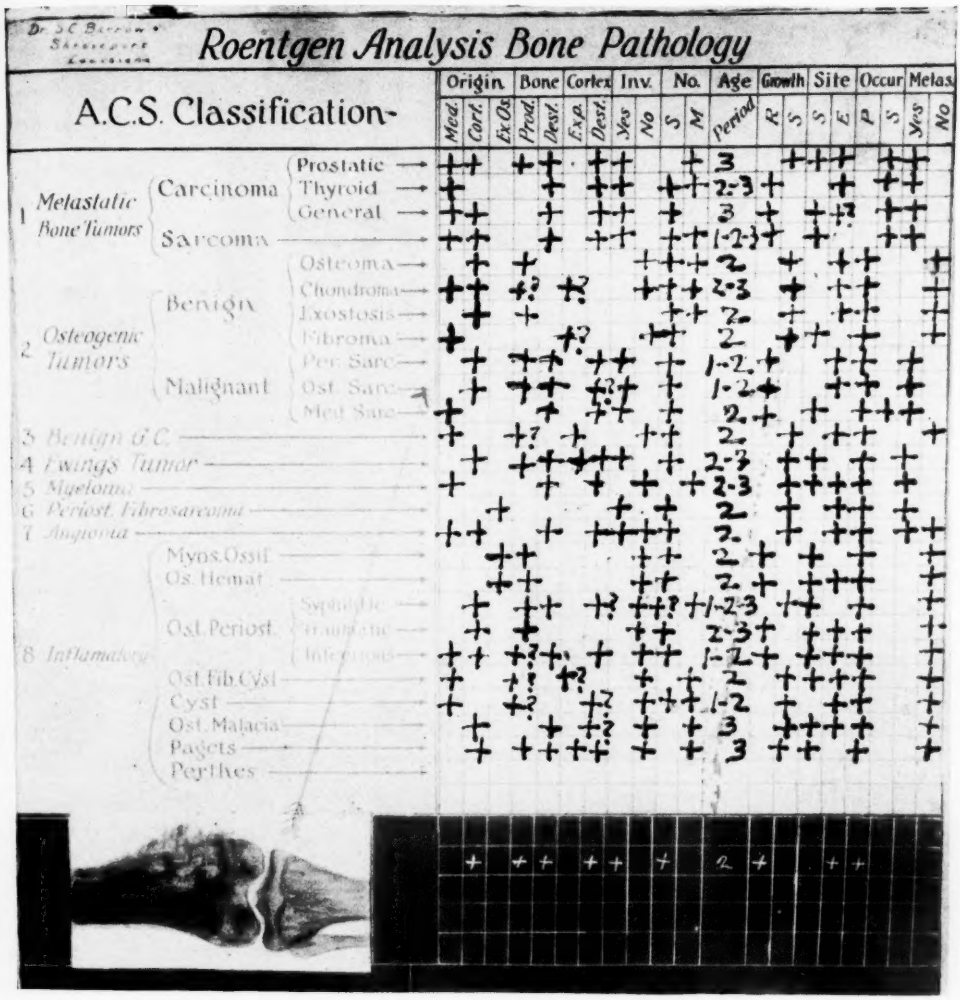

Fig. 4. Sample chart, showing method of checking: X-ray finding, osteosarcoma.

in the majority of instances we have found that we have allowed our minds to become centered on some one condition and have failed to study the evidence in favor of other conditions: that on studying a film which presented the appearance of a giant cell tumor we failed to consider it from the viewpoint of a simple cyst, a central chondroma, a fibroma, etc. Realizing the ever presence of this tendency and the difficulty of holding in mind the many conditions which might exist, we have arranged a chart (Fig. 1) which we have constantly at hand and which has been very helpful.

On this chart you will note, first, the classification as given by the American College of Surgeons, with sub-heads of nomenclature as usually used.* The data that can be gotten as a rule by X-ray study are

*For an explanation of the abbreviations used in these charts, see page 500, footnote 2.

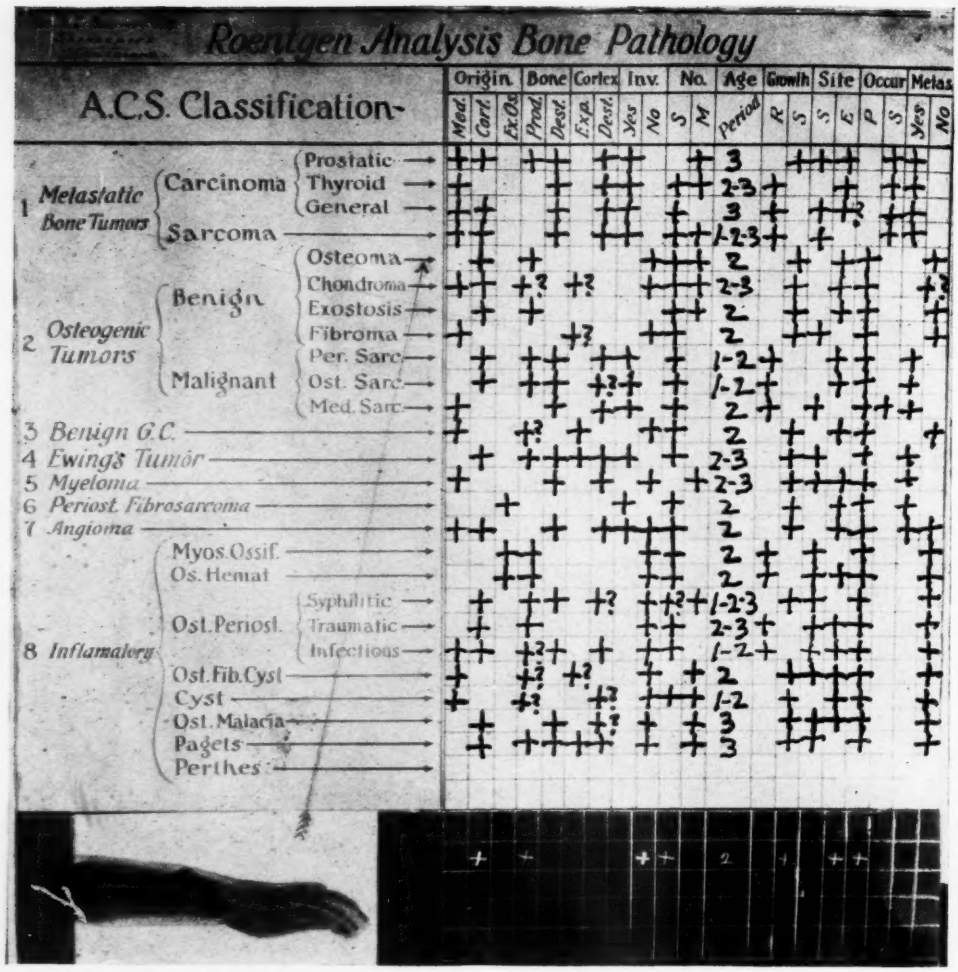

Fig. 5. Sample chart, showing method of checking: X-ray finding, osteoma.

arranged at the top of the chart, and opposite each sub-head the presence of an X-ray finding is indicated by a plus sign; if it is not usually present, a blank space is left. In some spaces you will note both a plus sign and a question mark, meaning that the condition at the top of the column is not always present or that it is questionable whether it is ever present.

Immediately beneath this chart are three blank spaces which are checked in, in accordance with the findings on the radiograph to be interpreted (Fig. 2). Now, on comparing these checks with the standard columns above, we note which ones it tallies with most nearly. We will then have sifted the probability down to one, two or three conditions, which, with more detailed study, can be further eliminated.

Figures 2, 3, 4, 5 and 6 illustrate con-

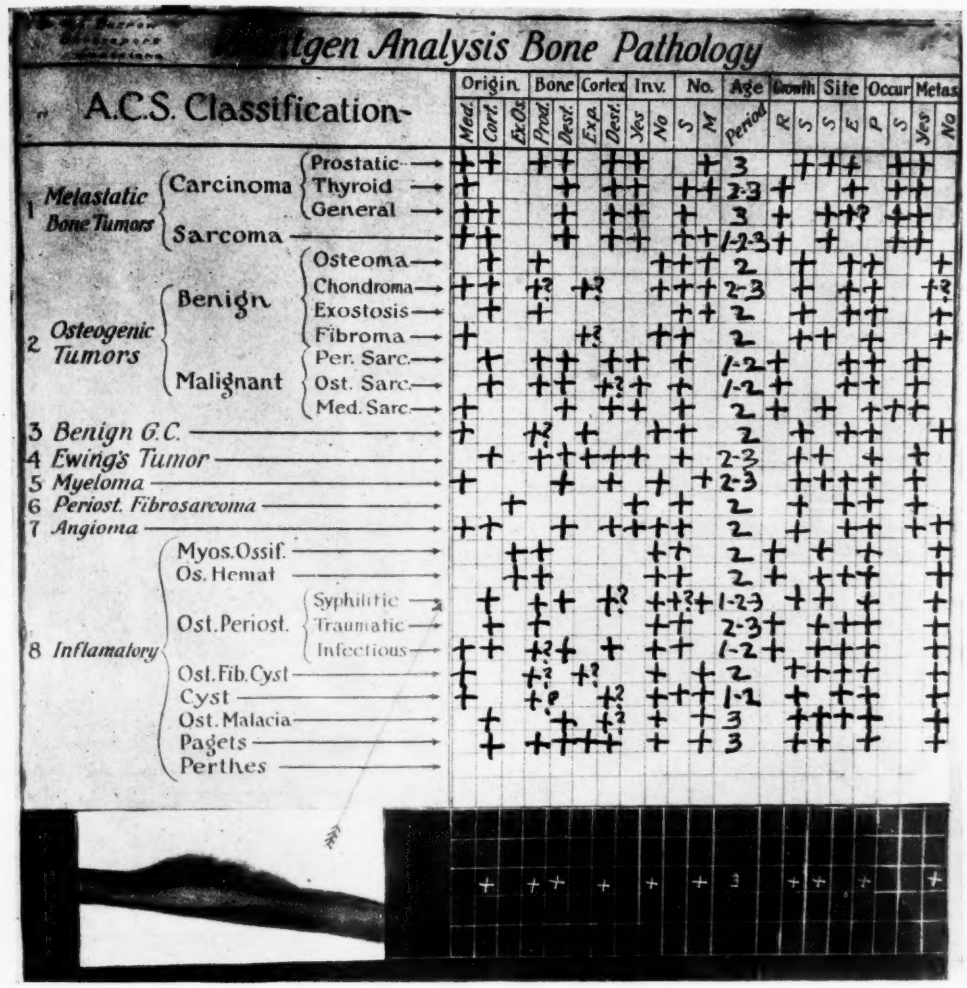

Fig. 6. Sample chart, showing method of checking: X-ray finding, syphilitic osteoperiostitis.

ditions as noted, and, on referring to Figure 1, the checks will be seen to correspond with the conditions named.

This suggestion is not offered as a guarantee against all errors, but as a help in guiding us past many.

POTTER-BUCKY TABLE ADAPTED FOR MULTIPLE EXPOSURES[1]

By HENRY K. TAYLOR, M.D., F.A.C.P., New York City

THE serialographs and polygraphs on the market, while serving a very useful purpose, are rather bulky and cumbersome. One type requires an additional table or support. Another type, which is heavy, has to be placed upon and removed from the table before and after use.

Where space is limited, and there is no room for an additional table, and to overcome the necessity of handling a heavy piece of apparatus, it has seemed to me that it might be worth while to adapt the Potter-Bucky table for making multiple exposures.

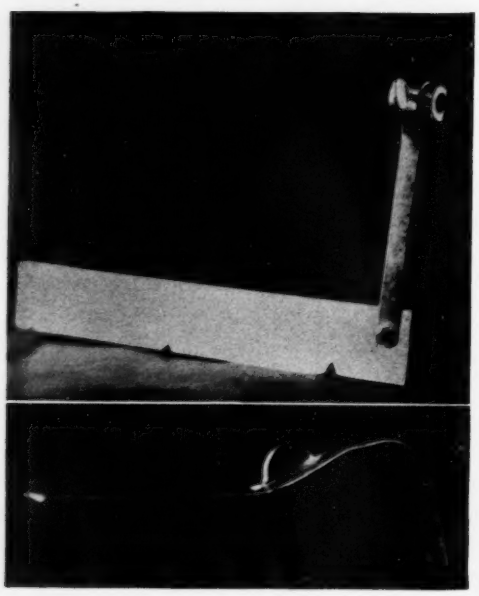

Fig. 1 (*above*). Shoulder which slides on rod alongside of table. The descending arm is fixed to the shoulder. Horizontal arm is attached by a rivet which permits motion. The notches are placed 4⅜ inches apart..

Fig. 2 (*below*). Indicator, constructed of pliable metal, 12 inches in length. Horizontal portion placed along guide line on lead sheet. Overhanging portion indicates position of cassette in tray for first exposure.

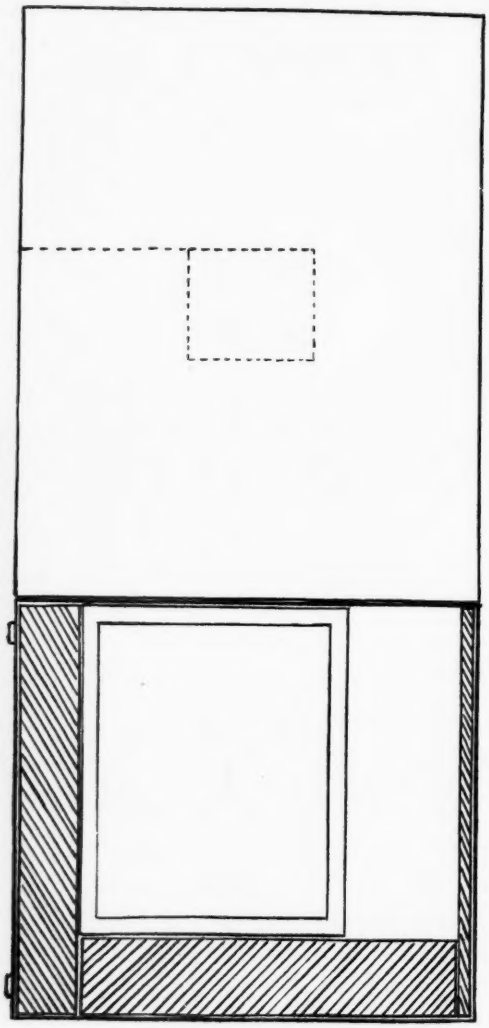

Fig. 3 (*above*). Sheet lead 20 × 25 inches enclosed in vello cloth envelope. The dotted rectangle corresponds to the opening, which measures 4⅜ × 5½ inches. The dotted line from the opening to the edge of the cloth is the guide for the horizontal portion of the indicator.

Fig. 4 (*below*). Schematic drawing of Bucky tray, containing three strips of wood which permit the entry of an 11 × 14 cassette (Edward), and a lateral shift of 5½ inches. The strips of wood measure 2⅞ × 19 7/16, 3 9/16 × 18⅛, and ⅝ × 19 7/16 inches.

[1]Presented before the New York Roentgen Society, March 19, 1928.

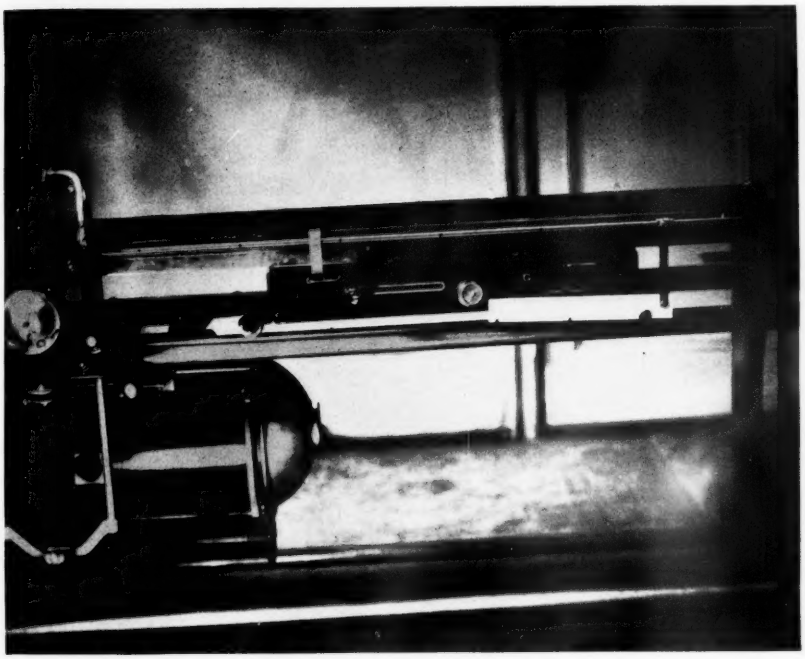

Fig. 5. Indicator in position. Shoulder fixed on rod. First notch resting on shaft of fastening nut of Bucky diaphragm. Position of first exposure.

It was rather surprising to find that, with a few simple items, at a very nominal cost, it was possible to accomplish this.

The device was adapted to an Acme-International Potter-Bucky table No. 3. With slight modification, I think it can be applied to any combination Potter-Bucky table and trochoscope.

The Acme table top has raised beveled edges. Within the depressed portion, which is 20 inches wide, is placed a piece of sheet lead (4 pounds to the square foot) measuring 20 × 25 inches. The exact center of the sheet lead is obtained, and an opening cut therein which measures 5 1/2×4 2/3 inches. The larger measurement of this opening is crosswise. This opening allows for six exposures on one 11 × 14 film (Fig. 3).

In order to avoid scratching the table top with the sheet lead, it is enclosed within a tightly fitting vello cloth (black) envelope. This permits easy movement, does not scratch the table top, and does not raise the patient more than 1/8 to 3/16 of an inch, and is not uncomfortable to rest upon. It is not necessary to remove this from the table while doing routine work, for it is easily displaced to either end of the table. The opening in the lead is easily discerned through the vello cloth. With the level of the upper limit of the opening, a straight line is drawn from the opening across the cloth towards the loading side of the table. A white thread is sewed along this line, to make a permanent mark, and is used as a guide which determines the position of the "indicator," and, in turn, the position of the tray for the first exposure.

Within the Bucky tray (Fig. 4), I have three strips of wood, which permit the entry of an 11 × 14 cassette, and also permit a displacement of 5½ inches crosswise. The three strips of wood are so arranged (U-shape) that half the width of the film cor-

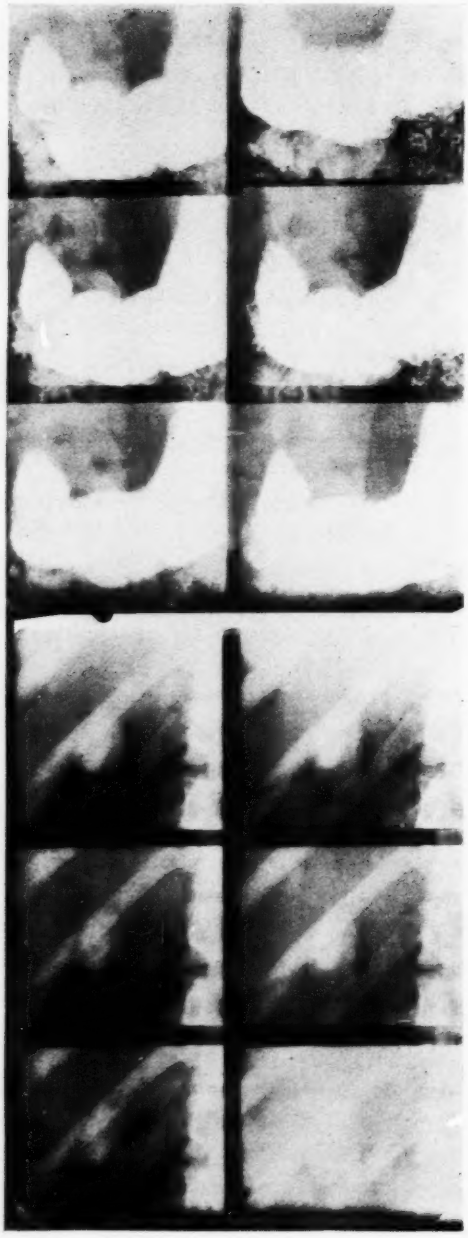

Fig. 6 (*above*). Multiple exposures of pylorus and duodenum.
Fig. 7 (*below*). Multible exposures of the gall bladder.

responds to the opening within the sheet lead on the table. Shifting the cassette crosswise brings the other half of the film under the opening.

The Acme table top is equipped with a rod along the entire side, which is ordinarily utilized for attaching a compression band. A shoulder, about one inch wide, which rides over this rod is constructed (Fig. 1). This shoulder has a descending arm fixed at right angles. There is also a wing nut which fixes this shoulder in position along any part of the rod. One end of a metal bar 11 inches in length is attached by means of a rivet to the lower end of the descending arm, which permits free motion at this junction. Along the lower edge of this bar there are three notches, placed 4 2/3 inches apart.

The "indicator" referred to above is a narrow strip of metal which is pliable, 12 inches in length, having a horizontal portion which rests upon the depressed table top, and a curved overhanging portion which conforms with the raised edge of the table. (Fig. 2). The overhanging portion reaches to a point 1/8 of an inch above the cassette in the Bucky tray.

In actual use, the procedure is as follows: The lead sheet is placed on the table. The patient is now fluoroscoped and the desired part brought into the field. The three strips of wood and the 11×14 cassette are now placed in the Bucky tray. The horizontal portion of the indicator is placed along the guide mark on the cloth-covered lead sheet. The grid is moved so that the edge of the film corresponds to the overhanging portion of the indicator, and then locked in place. The indicator is now removed. The sliding shoulder is attached to the rod and fixed so that the notch, nearest the descending arm in the movable crossarm, rests upon the shaft of the fastening nut of the Potter-Bucky diaphragm (Fig. 5). This is the position for the first exposure. For the second exposure, the grid is moved so that the fastening nut corresponds with the second notch, and for the third exposure it is again moved to the third notch. After the third exposure, the cassette is shifted 5½ inches in the tray and is in place for the fourth

exposure. The grid is moved for the fifth exposure to the middle notch, and for the sixth exposure it is back to the first notch.

Figure 6 shows multiple exposures of pylorus and duodenum, of an individual weighing 115 pounds, taken in 3/20ths of a second at 32-inch distance, with a gas tube. Multiple exposures of the gall bladder are made when examining by the Graham method. Here this device gives the greatest satisfaction for it saves considerable time and also expense.

Regarding the Irradiation of the Entire Human Body in Blood Diseases. Werner Teschendorf. Strahlentherapie, 1927, XXVI, 720.

The author treated a few cases of leukemia and of Hodgkin's disease by exposing the whole body at 150 cm. target distance (180 K.V., 5 Zn. plus 2.0 Al., half value layer in copper 0.75 mm., E.D. = 750 minutes). It is advisable to administer very small doses, approximately 0.5 to 3 per cent E.D., over the anterior and posterior body. In leukemia, the effect is essentially the same as that obtained by exposure of the spleen only; favorable results were recorded in cases of malignant granuloma. The small number of patients does not permit definite conclusions and this report is preliminary and intended to induce other investigators to give the method a trial.

E. A. POHLE, M.D.

Regarding the Artificially Increased Penetrability of the Skin for Bactericidal Light Rays. W. E. Pauli and H. Kliewe. Strahlentherapie, 1927, XXVI, 767.

Previous experiments lead to the conclusion that the penetrability of the skin for short ultra-violet rays is increased by an application of alcohol glycerin solution. In order to study the depth effect of bactericidal ultraviolet rays, cultures of staphylococci and streptococci and vibrio Metschnikoff were exposed through a piece of unprepared and a piece of prepared skin. A mercury vapor lamp was used in the experiments. Twenty-minute exposures through normal skin had no effect on the growth of the cultures, while ten-minute exposures through skin painted with alcohol glycerin solution had a definite inhibiting effect.

E. A. POHLE, M.D.

CASE REPORTS AND NEW DEVICES

ANKYLOSIS OF JOINTS

CASE REPORT

By JOSEPH L. HARVEY, M.D.

University of Colorado School of Medicine and Hospitals

DENVER, COLORADO

The patient, Mr. B. S., age 35 years, had had chicken pox, measles, whooping cough, with no sequelæ. He stated that he had been normal at the age of 22 years, but that between that age and 25 he had had three attacks of "rheumatism" (some type of severe arthritis). He entered the hospital because of (1) shortness of breath, (2) palpitation, (3) swelling of ankles, (4) headaches, (5) high blood pressure (220/160).

Heart and kidney disease and ankylosis began following the attacks of arthritis. In spite of handicaps, the patient had worked, up to four months prior to entering hospital, driving a team on a farm. Except for the upper extremities, there was ankylosis of practically all joints.

X-RAY REPORT

The disease process is similar in all joints involved, characterized by marked decalcification of bone and showing as finely penciled striæ, clear-cut outline, no haziness; absence of joint spaces and surfaces. The striæ continue across former articular surfaces, giving firm bony union.

Fig. 1. Complete fusion of tarsal bones and metatarsals with tarsals and most of phalanges.

Fig. 2. Bone striæ crossing former ankle joint, outline of which it is barely possible to make out in original negatives. Complete fusion of tibia, fibula, and tarsals.

Exact classification of the condition was not determined. Suggested diagnoses were: (1) ossifying arthritis; (2) arthritis deformans atrophica chronica, proliferative type.

Autopsy findings were those of chronic passive congestion and amyloidosis of spleen, kidneys, and adrenals. The cause of death was myocarditis.

Fig. 3. Complete ankylosis of patella, femur, and tibia. Posterior bowing of lower end of femur.

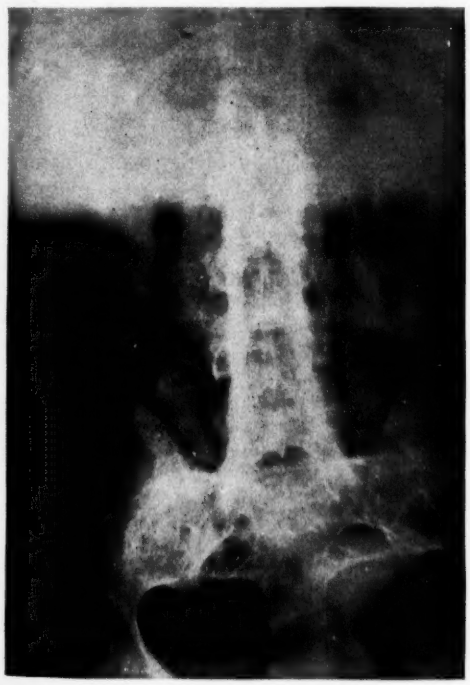

Fig. 4. Rigid spine and sacro-iliac joints, due to bony fusion. Note reinforcement columns on both sides of vertebræ.

Fig. 5. Complete bony fusion of cervical vertebræ. Skull negative. Mandible freely movable.

A NEW METHOD OF USING THE BUCKY-POTTER DIAPHRAGM

WITH SOME ADVANTAGES[1]

By W. S. LAWRENCE, M.D., B.S., F.A.C.R.
X-ray Department, University of Tennessee,
MEMPHIS, TENNESSEE

There are two inherent defects in nearly all large roentgenograms: One is distortion and the other is the lack of uniformity of exposure of the parts of the film underlying the thinner and the thicker parts of the body. This latter condition results in films correctly exposed for some regions but grossly over-exposed for others. While such films are diagnostic for the correctly exposed parts, they are anything but pleasing to the eye, and in some cases may cause unsuspected pathology to be overlooked.

In making 14×17 films of the genito-urinary tract of a patient of the broad, angular, thin, and scaphoid belly type, we see these defects accentuated. If, in such

[1]Read before the Radiological Society of North America, at the Twelfth Annual Meeting, at Milwaukee, December, 1926.

patients, sufficient exposure is given to secure fine detail and contrast in the region of the true pelvis, the flank regions—and likely the lower poles of the kidneys—will be so blackened that much of the detail will

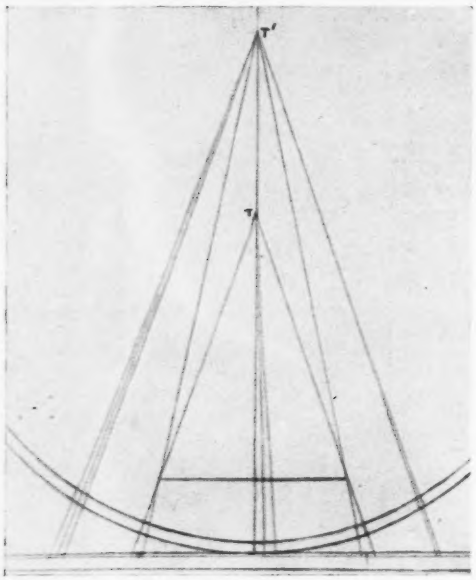

Fig. 1. T is at target distance of 25 inches. T' is 38 inches from the film. The reason for decreased distortion with the target at T' is obvious. Rays from T pass freely between the grid strips, being parallel to the planes of the strips, but rays from T' will be more and more intercepted by the upper and lower margins of the strips as we pass from the center of the film toward its sides. This interception gives the desirable decreased exposure of the outer portions of the film.

be lost. The iliac crests and great trochanters are over-exposed and distorted to a very unpleasing degree.

The method of using the Bucky-Potter diaphragm which I am offering for your consideration enables us to make films in which the defect of unequal exposure is eliminated to no inconsiderable extent. The distortion defect seen in all Bucky films made in the usual way is also minimized.

This method of using the diaphragm is confined largely to kidney films, and films of the whole pelvis.

The method is so simple and based on such a non-intricate geometric theorem that I have hesitated to present it, thinking that many may already be using it, and regarding it as hardly worthy of mention. I have, however, inquired of a good many roentgenologists and distributors of X-ray apparatus, all of whom have replied that they know of only one way of using the Bucky, which is at a film-target distance of 25 inches. Those to whom I have suggested another method are using it now as a routine procedure.

The method of procedure is this: Increase the film-target distance from 25 inches to 38 inches; increase the amount of exposure in the proper ratio, and proceed as usual with the exposure.

The advantage of increased distance in lessening distortion is quite obvious. How the lessened amount of exposure of those parts of the film underlying the thinner parts of the patient, namely, the lateral aspects, is accomplished will be made clear by reference to Figure 1.

The geometery involved may be expressed in the following theorem: If two circles, one within the other, are tangent to the same straight line, the angle formed by their respective radii at the point of tangency, T, is *nil;* and if an arc, TN, be described on the smaller circle, the angle formed by the radius of the smaller circle and the radius of the larger circle passing through the point N will vary directly with the arc TN and also with the radius of the larger circle. If, now, these values fall within practical limits, we have a working proposition. It so happens that they do.

It is obvious from Figure 1 that the central rays from the more distant target will pass unobstructed through the grid, and also that, passing outward toward the thinner parts of the patient, the rays from the more distant target will be more and more obstructed. With the target at 38 inches the outer portion of a 17-inch film receives only

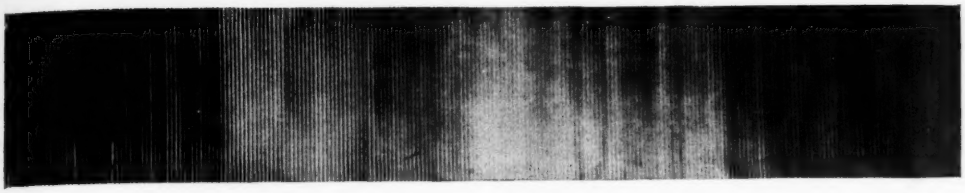

Fig. 2. A 17-inch strip of film exposed under the stationary grid at a target distance of 38 inches. Note that the central portion of the film, which would be under the thickest parts of the patient, has received approximately twice the amount of exposure that is received by the outer portions, which would be under the thinner lateral aspects of the patient.

about one-half the amount of exposure received by the central portion. This is very well seen from Figure 2, which is a 17-inch strip of film exposed at 38 inches with the grid stationary.

The advantages of this procedure in bringing out soft tissue detail are quite obvious from the examination of films made in this way, but, "as you all do know," soft tissue detail is very difficult to transmit to lantern slides. The slides which are to follow will, however, show quite clearly the decrease in distortion.

DISCUSSION

DR. L. T. LEWALD (New York City): Dr. Lawrence brought out the fact that there is a great deal of latitude in the distance at which you can use the Bucky diaphragm. Beginning about five years ago I found this out. Many exposures are made at a distance of 36 and even 48 inches, and I frequently stereoscope across the table at a distance of 48 inches, and take teleoroentgenograms at 6 feet with the Bucky and stereoscope occasionally at that distance without getting any appreciable grid.

DR. LAWRENCE (closing): I have little further to say except that I hesitated to bring up this subject, thinking that most of you might already be using the method which I suggest. However, not a few have always been under the impression that since a Bucky is constructed on a radius of 25 inches, it can be rightly used only at that distance.

This is a working proposition, with a reason back of it. It certainly gives films of

Fig. 3. Film of pelvis made at the usual target distance of 25 inches. Note marked distortion and gross over-exposure of the iliac crests.

Fig. 4. Same pelvis as Figure 3, but made at a target distance of 38 inches. Note lessened distortion of whole pelvis and particularly lessened exposure of iliac crests.

superior quality, with lessened distortion, and lessened exposure of those parts of the film which by the older method were so frequently over-exposed.

I am sorry I have not been using this method at so great a distance as has Dr. LeWald. Greater distances may be used, but with small films only. If a 17-inch film is used in a Bucky at a distance greater than 45 inches, the outer three or four inches of the film will be blank. The too nearly parallel rays at this distance will be entirely intercepted by metal strips of the grid over the outer parts of the film.

Relation of the Pylorus to Duration of Experimental Gastric Ulcer. Walter Hughson. Archiv. Surg., July, 1927, XV, 66.

In 1916 Bolton found that ulcerations of the mucosa produced by the intravenous injection of foreign proteins persisted for a much longer period if the pylorus was almost completely closed. The essayist has shown in a previous paper that irritation of the parietal or visceral peritoneum in experimental animals will produce a pylorospasm which manifests itself by great delay in the emptying time of the stomach. The relation of reflex spasm to the development of gastric ulcer suggests itself, in view of the fact that when patients present themselves they have fully developed gastric or duodenal ulcers and give a long preliminary history attributable to chronic inflammation of some abdominal viscus, most commonly the appendix or gall bladder. Gastroenterostomy cures by draining the stomach and relieving the spasm of the sphincter.

Experimentally produced ulcers on the lesser curvature of the dog's stomach result in a delayed emptying of the stomach in the presence of an intact pylorus.

Splinting of the pylorus in these experimental animals obviates this delayed emptying.

In the animals in which delay is demonstrated, ulcerations remain active at least twice as long as in the group in which the emptying is more rapid. This delay is due to reflex contraction of the pyloric sphincter.

LE ROY SANTE, M.D.

Concerning the Signification of the Vascular Permeability for the Radiation Therapy of Malignant Tumors. Gustav Peter. Strahlentherapie, 1927, XXVI, 735.

The history of a case of an epithelioma of the conjunctiva is related, which leads the author to a new hypothesis explaining the therapeutic effect of irradiation. He believes that an increase in the permeability of the blood vessels and local hyperemia are the reactions induced by a therapeutic irradiation.

E. A. POHLE, M.D

EDITORIAL

M. J. Hubeny, M.D. . . . . *Editor*
Benjamin H. Orndoff, M.D.
John D. Camp, M.D. *Associate Editors*

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HYPERSENSITIVENESS OR IDIOSYNCRASY

Some considerable confusion in the interpretation of what is meant by hypersensitiveness or idiosyncrasy appears to have arisen in the discussion of the effects of the roentgen rays upon human tissues.

Authorities of high standing have gone so far as to deny the existence of idiosyncrasy, but in the same breath they admit the well known and unquestioned fact that some individuals will tolerate much more or much less than the usual dosage. This they call "dosage intolerance" and "over-tolerance," which, in our opinion, is in every way exactly what is meant by the older and better known term "hypersensitiveness" (when intolerance is referred to).

As physicians, all of us have met with patients who could tolerate only very small doses of drugs, and others who could freely take double or triple the average dose. As radiologists, we have had patients whose skins became reddened after the application of much less than the minimal E.S.D.

Human sensitiveness manifests itself by reaction to stimuli. These reactions are produced in greater or lesser degrees, depending upon the sensitiveness of the tissues or organs of the individual, and the degree or intensity of the stimulus. Consequently all degrees of reactions, from the most minute to the greatest, may be produced by exactly the same stimulus, depending upon the sensitiveness of the individual, tissue, or organ stimulated or acted upon. This statement may seem trite and commonplace, but we are discussing commonplace happenings and must consider them as everyday affairs. We meet them every day.

Now then, reasoning from these premises, would it not be far better for all of us to retain the old terminology, and call these reactions wherein more than the expected effect is produced, hypersensitiveness or idiosyncrasy? This is the effect where a definite and distinct understanding is needed. The old terminology has been in use in medico-legal and court proceedings for a long time, and has found a place in recognized and frequently quoted decisions from courts of last resort, as well as being recognized and understood by lawyers and courts. They know what we mean and we know what they mean when these terms are used, and the terms themselves are sufficiently accurate descriptions of the conditions we want to explain and specify. We will do well to "let well enough alone," and not get into the habitual use of the hair-splitting nomenclature of our good friends and highly respected colleagues, the dermatologists. *Experte credite.*

I. S. Trostler, M.D.

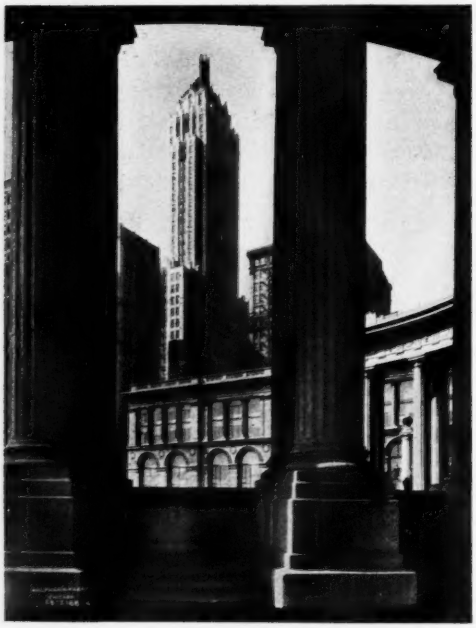
"CHICAGO'S GREATEST RADIOLOGICAL SESSION"

The Fourteenth Annual Session of the Radiological Society of North America will be held in the Drake Hotel, Chicago, December 3 to 7, inclusive, 1928. This Fourteenth Annual Session should be one of the

largest and most interesting in the history of the Society.

The scientific meetings, special clinics, and clinical demonstrations will be of the highest quality.

Over 8,000 square feet will be used for the Commercial Exhibit and 5,700 square feet for the Scientific Exhibit. This wonderful space should provide for the largest and most instructive commercial and scientific exhibits the Society has ever had.



Chicago presents many points of interest to visitors. The new Pittsfield Building, shown here, is largely devoted to doctors' offices.

The management of the Drake Hotel has made a special rate for the week of our session. The membership and guests of the Society are thus assured of exceptionally reasonable hotel rates. There will be ample accommodations at the Drake Hotel for all members and guests. There will be no other convention at the Drake Hotel during the week of the meetings of the Radiological Society.

The railway transportation companies have also offered a special rate of one and one-half fare round trip covering the entire United States and all of Canada east of Winnipeg.

The local committees at Chicago are working hard to provide facilities for the greatest radiological session ever held in Chicago.

Members are urged to make their reservations early.

Make your plans now to attend "Chicago's Greatest Radiological Session."

For reservations communicate with *Chairman of Hotels and Lodgings Committee,* F. J. Ronayne, M.D., West Suburban Hospital, Chicago, Illinois.

AMERICAN RADIUM SOCIETY

The Thirteenth Annual Meeting of the American Radium Society will be held at Hotel Radisson, Minneapolis, Minnesota, during the week of the American Medical Association conference.

The Scientific Session will convene Monday, June 11, at 9:00 A.M., and the discussions and clinics will continue throughout the following Tuesday.

The preliminary program is as follows:

MONDAY MORNING, JUNE 11, 1928

(A) 9:00 A.M. Executive Business Meeting; Report of Committees.

(B) 10:00 A.M. Scientific Session.

1. ADDRESS BY THE PRESIDENT—Curtis F. Burnam, M.D., Baltimore, Maryland.

2. "Treatment of Hygroma Cystica with Radium"—F. A. Figi, M.D., Rochester, Minnesota.

3. "Plantar Warts: Their Treatment by Radiotherapy"—Laurence R. Taussig, M.D., San Francisco, California.

4. "Urethral Caruncle"—R. E. Loucks, M.D., Detroit, Michigan.

(C) 2:00 P.M. Executive Business Meeting.

(D) 3:00 P.M. Radium Clinics. (Cancer Institute of the University of Minnesota, conducted by Dr. A. C. Strachauer and Staff.)

(E) 6:30 P.M. ANNUAL BANQUET OF THE AMERICAN RADIUM SOCIETY.

Address by: W. J. Mayo, M.D., of the Mayo Clinic. Subject to be announced.

Address by: A. C. Strachauer, M.D., Director of the Cancer Institute of the University of Minnesota. Subject to be announced.

Address by: S. C. Lind, M.D., Director of the School of Chemistry of the University of Minnesota. Subject to be announced.

TUESDAY MORNING, JUNE 12, 1928

(F) 9:00 A.M. Executive Session. Short Business Meeting.

(G) 9:15 A.M. Scientific Session.

5. "A Basis for Dosage Determination in Interstitial Radiation"—Edith H. Quimby, M.A., and Hayes E. Martin, M.D., Memorial Hospital, New York City.

Discussion to be opened by: K. Wilhelm Stenstrom, Ph.D., Minneapolis, Minn.; A. Weatherwax, M.A., Philadelphia, Pa.; Curtis F. Burnam, M.D., Baltimore, Md.; Edwin C. Ernst, M.D., St. Louis, Mo.

6. "The Use and Abuse of Radium Implants"—Albert Soiland, M.D.; William E. Costolow, M.D., and Orville N. Meland, M.D., Los Angeles, California.

7. "Experiences to Date with the Four Gram Radium Element Pack"—James J. Duffy, M.D., New York City, N. Y.

8. "Radium in the Treatment of Carcinoma of the Uterine Cervix during 1927"—H. H. Bowing, M.D., Rochester, Minnesota, and Robert E. Fricke, M.D., Baltimore, Maryland.

9. "Mixed Salivary Tumors"—B. F. Schreiner, M.D., and Walter Mattick, M.D., Buffalo, New York.

10. "Recent Experiences with Cases of Carcinoma of the Mouth"—J. Douglas Morgan, M.D., Philadelphia, Pa.

11. "The Treatment of Epithelioma of the Penis by Radiotherapy and Electrocoagulation"—G. E. Pfahler, M.D., and B. P. Widmann, M.D., Philadelphia, Pa.

Discussion to be opened by: B. S. Barringer, M.D., New York City; Albert Soiland, M.D., Los Angeles, California; B. C. Corbus, M.D., Chicago, Illinois; G. E. Ward, M.D., Baltimore, Maryland.

SYMPOSIUM: "TREATMENT OF NON-MALIGNANT UTERINE LESIONS"

12. (*a*) "Benign Uterine Hemorrhages"—Henry Schmitz, M.D., Chicago, Illinois.

13. (*b*) "Review of the Treatment of Uterine Fibroids with Radium"—William Neill, M.D., Baltimore, Maryland.

14. (*c*) "Treatment of Hemorrhage from the Non-malignant Uterus"—O. L. Norsworthy, M.D., F.A.C.S., Houston, Texas.

Discussion to be opened by: H. H. Bowing, M.D., Rochester, Minnesota; C. F. Burnam, M.D., Baltimore, Maryland.

All members of the American Medical Association are cordially invited by the President of the American Radium Society, Doctor Curtis F. Burnam, to attend the Scientific Session and the Banquet Program.

EDWIN C. ERNST, M.D.
Chairman, Program Committee,
AMERICAN RADIUM SOCIETY.

AMERICAN ESSAYISTS AT THE SECOND INTERNATIONAL CONGRESS OF RADIOLOGY

STOCKHOLM, JULY 23-27, 1928

"Opaque Foreign Bodies in the Air Passages"—Willis F. Manges, M.D., Philadelphia, Penna.

"Cholecystography in America"—B. R. Kirklin, M.D., Mayo Clinic, Rochester, Minn.

"Peptic Ulcer"—Lewis Gregory Cole, M.D., New York City.

"Chronic Partial Obstruction of the Duodenum"—H. M. Imboden, M.D., and Ramsay Spillman, M.D., New York City.

"Acute, Massive Atelectasis (Collapse) of the Lung, with Especial Reference to Its Occurrence as a Post-operative Complication"—David R. Bowen, M.D., Philadelphia, Penna.

"A Plea for the Standardization of the Technic in the Oral Method of Cholecystography"—William H. Stewart, M.D., New York City.

"Some Results of a Study of Roentgenograms of the Abdominal Viscera"—Robert O. Moody, M.D., and Roscoe G. VanNuys, M.D., University of California, Berkeley, Calif.

"The Significance of the Cecocolic Sphincteric Tract in Gastro-intestinal Diseases: A Roentgenological Study"—I. Seth Hirsch, M.D., New York City.

"Radiosensitive Epidermoid Carcinomas"—James Ewing, M.D., Cornell University Medical School, New York City.

"The Treatment of Cancer of the Tongue"—Douglas Quick, M.D., New York City.

"Radiation Therapy of Bone Tumors"—William A. Evans, M.D., and T. Leucutia, M.D., Detroit, Mich.

"End-results of Radiation Therapy in the Treatment of Malignant Tumors of the Thyroid Gland"—U. V. Portmann, M.D., Cleveland Clinic, Cleveland, Ohio.

"A Critical Survey of Radiation Therapy in Exophthalmic or Toxic Goiter"—Albert Soiland, M.D., William E. Costolow, M.D., and Orville N. Meland, M.D., Los Angeles, Calif.

"Technic and Results of Radium and Roentgen-ray Treatment of Bladder Tumors"—Hugh H. Young, M.D., and Charles A. Waters, M.D., Brady Urological Institute, Baltimore, Md.

"X-ray Dosage and Its Measurement"—William Duane, Ph.D., Harvard Medical School, Boston, Mass.

"A New Method of Measuring Very Small Electric Currents: Some Practical Applications"—G. Failla, E.E., D.Sc., Memorial Hospital, New York City.

"Practical Dosimetry in Electrostatic *R*-units over a Wide Range of Wave Lengths (0.02Å – 3.0Å) Achieved by Means of Condenser Dosimeter"—Otto Glasser, Ph.D., U. V. Portmann, M.D., and V. B. Seitz, Cleveland Clinic, Cleveland, Ohio.

"The Albumin-globulin Index in the Serum and the Suspension Stability of the Blood as Prognostic Aid in Malignant Disease"—Ernst A. Pohle, M.D., University Hospital, Ann Arbor, Mich.

"The Electrical Treatment of Subacromial Bursitis"—Norman E. Titus, M.D., New York City.

"The Value of Iodized Oil Displacement Method in the Roentgen-ray Diagnosis of Paranasal Sinus Disease"—Edwin C. Ernst, M.D., and Arthur W. Proetz, M.D., St. Louis, Mo.

"Diaphragmatic Hernia: Differentiation from Thoracic Stomach, Absence of the Left Half of the Diaphragm, and Eventration of the Diaphragm"—Leon T. LeWald, M.D., New York City.

"Wave Length and Biological Action"—Francis Carter Wood, M.D., Institute of

Cancer Research, Columbia University, New York City.

"The Transmission of Ultra-violet Light through the Human Skin and Its Constituents"—A. Bachem, Ph.D., and J. Kunz, Ph.D., Department of Radiology, University of Illinois, Chicago, Ill.

"Further Observations on the Saturation Method in Radiation Therapy as Applied to Deep-seated Malignant Disease, with Some Statistical Studies"—G. E. Pfahler, M.D., and B. P. Widmann, M.D., Philadelphia, Penna.

"The Prognostic Value of Histo-pathological and Clinical Grouping of Carcinomata of the Uterine Cervix on Five-year End-results"—Henry Schmitz, M.D., Chicago, Ill.

"X-rays, Ultra-violet and Desiccation in Tonsil Treatment"—William D. McFee, M.D., Haverhill, Mass.

"Massive (Atelectatic) Collapse of the Lungs"—L. R. Sante, M.D., St. Louis, Mo.

BOOK REVIEWS

X-RAYS AND RADIUM IN THE TREATMENT OF DISEASES OF THE SKIN. By GEORGE M. MACKEE, M.D., Professor of and Director of the Department of Dermatology and Syphilology, New York Post-graduate Medical School and Hospital; Member American Dermatological Society, American Roentgen Ray Society and American College of Radiology; Member New York Dermatological Society, New York Roentgen Society; Fellow New York Academy of Medicine, etc. Second and revised edition. Published by Lea & Febiger, Philadelphia, 1927. Pages 788. Price $10.00.

This book has long been the accepted standard in its particular field and it is gratifying to see a new edition, completely revised and rewritten. The revision includes 174 additional pages, 104 illustrations, 9 charts, a number of tables, a dozen diseases, and over 300 literary references.

The chapters concerning physics, apparatus and dosage measurements have been largely rewritten and modernized. They constitute in the mind of the reviewer one of the best practical and comprehensive expositions of the subjects obtainable.

The subject of radium technic has been greatly amplified. This chapter now includes many photographs and excellent drawings of the various applicators and their manner of use.

The general arrangement of the various dermatological lesions and their method of treatment has been maintained. Improvements in technic have been inserted and the bibliography greatly amplified.

The practical and scientific value of this text-book cannot be over-estimated. It reflects through the careful and scientific attitude of the author, whose work has been and will continue to be a real contribution to the sciences of roentgenology and dermatology.

LA HAUTE FREQUENCE EN OTO-RHINO-LARYNGOLOGIE. LEROUX - ROBERT. Masson & Co., Paris, second edition, 1927; pages 216, price 26 francs.

This is a revision of the first edition, which appeared in 1925. This little book is an interesting contribution on the use of high frequency currents in oto-rhino-laryngology, and should appeal to anyone who wishes to familiarize himself with such applications. The views presented are sane, and, in the present state of our knowledge of the action of high frequency currents, reasonably conservative. This revision consists chiefly in the addition of more case histories and more illustrations, a few of which, unfortunately, do not illustrate well. There have also been added two tables on technic. Perhaps the most important addition has been in the last chapter and relates

to the production and use of ultra-violet rays in this field.

A. U. DESJARDINS, M.D.

HANDBUCH DER RÖNTGEN- UND RADIUMTHERAPIE. Ein Lehrbuch für Arzte und Studierende. Dr. med. J. von Wetterer, Spezialarzt für haut-, Harnkrankheiten und Strahlentherapie. Begründer und Herausgeber der Internationalen Radiotherapie. E. M. der S. M. Elektro-Radiologia in Mannheim. Band II (Volume II), 1928. Otto Nemnich, publisher. Dark blue cloth, 784 pages, 161 text figures, 25 colored plates, and 6 full-page black and white plates. Paper is good and binding serviceable.

This, the second edition of this work on roentgen and radium therapy, covers the entire field of the subject in an exhaustive and most comprehensive manner. The different branches of the subject are well classified and thoroughly cross-indexed, so as to render a large amount of information accessible. The book is divided into 19 general heads, in addition to the introductory chapter, as follows: Introduction to Dosimetry of Roentgen Rays; Anomalies of Hair Growth and Diseases of the Hair and Hair Follicles; Dermatoses; Malignant Tumors (204 pages); Benign Diseases of the Female Genitalia; Diseases of the Blood and Hematopoietic Organs; Tuberculosis; Diseases of the Endocrine Glands; Diseases of the Respiratory Tract Exclusive of Tumors and Tuberculosis; Diseases of the Circulatory System; Diseases of the Digestive Tract Exclusive of Tumors and Tuberculosis; Diseases of the Muscles, Bones, and Joints; Diseases of the Central and Peripheral Nervous Systems; Roentgenotherapy of Oto-rhino-laryngology; Diseases of the Teeth and Alveolar Processes; Roentgenotherapy of Eye Diseases; Roentgenotherapy in Urology; Roentgenotherapy in Infectious Diseases; Roentgenotherapy in Pyogenic Diseases of Lymph Glands and Venereal Bubo; Roentgenotherapy in Pyococcic Infections.

Each of these 19 general heads is subdivided into numerous disease entities, discussed separately, and in numerous instances illustrated by text figures—of which there are 161.

The 25 full-page colored plates very well illustrate what they are intended to, and make a valuable addition to this book.

The bibliography is fairly complete regarding the late and more recent references.

While this author claims much more for roentgenotherapy than does any modern American, and embraces a much broader clinical field than we Americans have ever dared, the book is none the less very valuable and should be in the library of all who read German.

I. S. T.

ABSTRACTS OF CURRENT LITERATURE

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Extensive Sarcoma of Skin Treated by Unfiltered Roentgen Ray. Lloyd F. Craver. Archiv. Dermatol. and Syphilol., 1927, XVI, 35.

The author describes the history and treatment by roentgen ray of a case of multiple tumor formation in the thighs and about the breast of a full-blood male negro, aged 53. The tumors were very numerous in the left thigh, where the trouble had begun three months before. They were ulcerating and bleeding, causing so much odor that the patient could not be admitted as an in-patient at Memorial Hospital, New York, and had to be treated as an out-patient. The clinical diagnosis was multiple hemorrhagic sarcoma of Kaposi, though lacking some characteristic features. Ewing's microscopical diagnosis was "hemorrhagic large spindle cell sarcoma. It seems most probable that the tumor is a neurosarcoma. The structure is not typical of Kaposi's hemorrhagic sarcoma." Roentgen treatment: without filter, target skin distance 37.5 cm., 5 ma. spark gap between blunt points 10 inches, 3 min., which gives a moderate erythema. Two large areas were treated. Beginning regression was noted in one week. At the end of two weeks some nodules had disappeared and there was more definite regression of other tumors. After three weeks two more areas were treated. Treatments were given at intervals of three weeks and after seven months all tumors were markedly regressed. He then developed a severe infection of the knee joint, which was opened and drained, numerous long-chain streptococci being found. No tumor involvement of the knee joint noted. The tumors in the breast and opposite thigh regressed with the rest, though the former had not been treated.

The questions as to whether the nodules were true tumors and whether the streptococcic infection was secondary or not were raised.

The technic of treatment was considered important. The unfiltered ray with peak voltages of 135,000, permitted needed action of soft rays on the ulceration and bleeding and assured a more favorable ratio of depth dosage to surface dosage.

R. H. STEVENS, M.D.

Regarding the Knowledge of the X-ray Sarcoma. S. Pförringer. Strahlentherapie, 1927, XXVI, 610.

Following a review of the literature, the author publishes the history of two cases, one boy five years old and one girl twelve years old, who were both treated with X-rays for tuberculosis of the elbow. Both developed, two and nine years, respectively, after the last treatment, a sarcoma in the elbow. It is possible that an over-dose administered during the course of X-ray treatments was responsible for the development of the malignancy.

E. A. POHLE, M.D.

Incandescent Lamp with Ultra-violet Transmitting Bulb. F. Dannmeyer. Strahlentherapie, 1927, XXVI, 413.

An incandescent lamp with a special glass bulb transmitting short ultra-violet rays down to 2,540 Ångstroms is described in this paper. Its ultra-violet energy corresponds almost exactly to that of the summer sun in Hamburg, Germany, namely, 90 to 100 volts per second for 1,000 watt input. This was measured with a cadmium photo-electric cell at 50 cm. distance. The red and infra-red part of the spectrum emits, however, much less energy than the corresponding part of the sun.

E. A. POHLE, M.D.

The Skin Erythema Dose, with a Combination of Two Types of Radiation. Edith H. Quimby. Am. Jour. Roentgenol. and Rad. Ther., June, 1927, XVII, 621.

Experimental work with two types of radium radiations, one consisting predominantly of beta rays, the other practically all gamma rays, showed that when the two types of radiation were combined over a given skin area, two-thirds the pre-determined dose of soft radiation must be immediately followed by two-thirds the dose of hard radiation, or *vice versa*, in order to produce the same erythema changes as a full dose of either. The explanation advanced is that different types of radiation either affect different cells, or different parts of the same cells to different extents.

J. E. HABBE, M.D.

The Dangers of Lipiodol as a Bronchopulmonary Injection. Editorial in "Canadian Medical Association Journal," June, 1927, XVII, 715.

An editorial in the *Canadian Medical Association Journal* calls the reader's attention to the paper of Archibald and Brown, published in the *Journal of the American Medical Association*, April 23, 1927, p. 1310. The article is a report of 100 injections done in the Royal Victoria Hospital, Montreal, with two fatalities. These resulted, one from "pleural shock," and one from rapidly spreading septic pneumonia. In addition, there was a flare-up of lung tuberculosis in three acute cases in which the injection was made.

These unfavorable results furnish the contra-indications against the use of the method. Patients severely ill with an infective lesion of the lung parenchyma, and patients in the active stage of lung tuberculosis should not be subjected to injection of lipiodol.

L. J. CARTER, M.D.

Regarding the Biology of Roentgen Rays. K. Kovács. Strahlentherapie, 1927, XXVI, 313.

The author discusses at length the hypothesis of Groedel, who believes that the surrounding medium of the solution plays an important rôle in the action of roentgen rays on tissue. Experiments on Paramecium undertaken by Kovács support this assumption. It seems that changes in the albumin molecule are probably responsible for the observed effects of radiation which often remind one of the symptoms following the injection of foreign proteins into organs.

E. A. POHLE, M.D.

Treatment of Menstrual Disorders by Roentgen Rays. A. J. Rongy. Am. Jour. Obst. and Gynec., May, 1927, XIII, 598.

The author first undertook the treatment of menstrual disorders by roentgen rays two years ago. The results in the first series of cases were so gratifying that further work along the same line was carried out. The action of the X-ray in bringing this about is not clearly known, but the author is of the opinion that further investigation will demonstrate the fact that its action is to produce degenerative change in the corpus luteum.

Patients benefited from other methods of treatment were not subjected to this method; only those failing to respond to any other treatment were treated with X-rays. Thirty-six cases in all were so treated and the results analyzed, these being almost uniformly favorable. The author concludes that the X-ray stimulates ovarian secretion and produces a

higher grade of fertility when judiciously applied. Eight of the 36 patients became pregnant after the treatment. All children born at full term were normal and continued to develop normally, showing that the X-rays had no effect on growth.

No details of the technic of the roentgen-ray treatments are given.

L. R. SANTE, M.D.

Central Sarcoma of Bone: Is There a Central Fibroma or Fibrosarcoma and How can it be Differentiated from Osteitis Fibrosa? J. C. Bloodgood. Jour. Bone and Joint Surg., April, 1927, IX, 217.

The author illustrates a central chondroma of the end of one of the long bones, and emphasizes the intact shell of bone. He recognizes chondroma formation arising not only from the medullary canal, but also from the periosteum, and states that the theory that chondromas arise from the epiphyseal line is wrong—they can occur wherever bone occurs. Wherever one finds chondroma one may also find myxoma. Myxoma may even be periosteal in origin. The latent or healing bone cyst which is occasionally seen in adults should not be mistaken for central newgrowth of malignant type.

An analysis of the cases classified in 1920 as malignant reveals many failures and gives material for revision of the classification. Cases thought to be sarcoma are still alive. No positive proof of a central sarcoma of bone of the fibrosarcoma type, with an intact bone shell, has been found. Fibrosarcoma is a well recognized periosteal tumor. The same tumor occurs in the lower jaw, but all cases with intact bone shell are borderline tumors between fibroma and fibrosarcoma.

A restudy of eleven cases diagnosed as various types of cellular sarcoma shows that in not a single case was there an intact bone shell.

It will be most helpful to operators and pathologists and roentgenologists if it is possible to make these facts in regard to central bone lesions clear. At this time we have, and from now on will have, a more enlightened public. The majority of our patients report immediately because of pain, swelling, limp, or loss of function, and when the X-ray examination is made, central lesions of bone are found to be surrounded by a definite bone shell. There may be a pathological fracture, and, in a few instances in adults, it may be the symptom of onset. It is very helpful, therefore, to know that the most common form of central sarcoma is the myxochondrosarcoma, which should be easily differentiated from fibroma or osteitis fibrosa by its fresh appearance in the frozen section. The bone aneurysm is identical in the gross with the hemorrhagic bone cyst within a giant-cell tumor. The fresh frozen section of the friable tissue lining the bone shell should distinguish one from the other. We also have a very practical rule: when in doubt, curette with thermal and chemical cauterization, because, up to the present time, in not a single instance has a verified myxochondrosarcoma reached the five-year limit, nor has the bone aneurysm (the malignant hemorrhagic bone cyst).

Among the living cases now approaching the five-year limit, there are two chondrosarcomas, both amputated; one myxoma (amputated), and one myxoma (curetted).

The author continues: "If you have, on the X-ray film, a definite bone shell, and the bone destruction is all within that shell and there is no evidence, in the X-ray film or on palpation, of any tumor formation outside the bone shell, and, at the exploratory incision, you find within the bone shell a mass of fibrous tissue difficult to distinguish from sarcoma in the gross and frozen section, you will be quite safe in concluding that you are dealing with osteitis fibrosa. Conservative measures are in order. If there are many minute cysts, or one large cyst, this is evidence still more positive of the benign bone cyst (osteitis fibrosa). If the patient is under twenty years of age, this is additional evidence that the lesion is benign.

"As more adults are X-rayed for sprains and contusions, for slight pain or limp as well as for fracture, we may expect to see more frequent evidence of the single, healed or latent bone cyst, and after definite injuries these quiescent lesions may grow . . .

"The predominant central lesions of bone

are osteitis fibrosa and the giant-cell tumor. Next in order of frequency comes the metastatic tumor. Chondroma, myxoma, and sarcoma, developing in one or the other or both, are not frequent tumors. The multiple myeloma, without evidence of other bone involvement, is a rare disease. It is time now for all of us to learn to recognize osteitis fibrosa and the giant-cell tumor in all their clinical, gross, microscopic, and X-ray variations.

"I trust the discussion of these four cases with their illustrations will be helpful, and I wish to repeat that up to the present time there is no positive evidence of a central fibroma or fibrosarcoma of bone, such as occurs in the lower jaw. If Case 2 had been seen with an intact bone shell and no tumor tissue outside the cortical bone, we would have definite evidence of a central sarcoma of the osteogenic type. But at present I have no evidence of such a tumor. The only type of central sarcoma is chondromyxosarcoma, which should be easily distinguished from the giant-cell tumor and osteitis fibrosa, and the very rare bone aneurysm which can be differentiated from the hemorrhagic giant-cell tumor in the frozen section."

L. R. SANTE, M.D.

Radiotherapy in Inflammatory Diseases of the Adnexa. G. Gambarow. Strahlentherapie, 1927, XXVI, 698.

The author reports the results of 123 cases of pelvic inflammatory disease, chiefly of gonococcal origin. His material is divided into there groups according to the dose effective in the diseased area: 5 to 6 per cent E.D. (61), 8 to 10 per cent (39), temporary sterilization with 28 per cent (23). Deep therapy radiation at 180 K.V. was used, 3 to 4 ma., 0.5 Zn. plus 3.0 Al., 23 to 30 cm. F.S.D., 6 × 8 cm. field of entry. The depth dose in 10 cm. depth for 23 cm. F.S.D. was 20 per cent; for 30 cm. F.S.D., 26 to 28 per cent, 1 E.D. = 19 to 22 minutes. The results in the group treated with small doses were not very encouraging. In view of the possible injury to future pregnancy, this procedure is not recommended. In chronic or sub-acute cases of inflamed adnexæ, temporary sterilization offers the best therapeutic effect. From the standpoint of precaution, however, it would be wise to induce temporary sterilization only if all other conservative measures have failed, or a future pregnancy is improbable.

E. A. POHLE, M.D.

The Roentgenotherapy of Whooping Cough and Some Conclusions Regarding its Pathogenesis. Z. v. Hrabovszky. Strahlentherapie, 1927, XXVI, 706.

In 65 cases of whooping cough, ages from two months to thirteen years, the liver was exposed to roentgen rays (160 K.V., 4 ma., 2 to 3 mm. Al., 31 cm. F.S.D., 150 to 350 *R* per field). The treatments were repeated after from five to ten days. It appeared that the therapeutic effect was the more striking the earlier the children came for treatment after the onset of the disease. The exposure of the liver (indirect effect) gave better results than the treatment of the hilum. Whooping cough is not only an infectious disease but is combined with a hypersensitivity to protein.

E. A. POHLE, M.D.

Some Effects of Roentgen Irradiation of the Heart in Rheumatic Carditis. Robert L. Levy and Ross Golden. Am. Jour. Roentgenol. and Rad Ther., August, 1927, XVIII, 103.

Twenty patients having rheumatic carditis, some acute cases with fever and others chronic afebrile cases, were irradiated over the heart through anterior and posterior portals, using the following factors: 200 K.V.P., 50 cm. target-skin distance, ½ mm. copper plus 1 mm. aluminum, 36 ma.-min. over the front and 54-72 ma.-min. over the back (one-tenth erythema dose delivered to the heart in the region of the mitral valve). Of the 20 cases treated, 17 showed definite improvement, one case very strikingly so, and in no instance was there any evidence that X-ray therapy had unfavorably influenced the disease or that the heart had been damaged, although about 40 per cent of the patients experienced general malaise, headache, nausea, or vomiting at

times, these symptoms normally coming late in the course of the treatments (18 cases received 4 or more treatments). Two cases of sub-acute bacterial endocarditis were treated without affecting the progressively fatal course of the disease. Electrocardiographic changes following roentgen therapy were considered directly related to the treatment and indicative of modification of the lesions. Teleoroentgenographic changes were not observed.

J. E. HABBE, M.D.

The Present Status of Cholecystography. B. R. Kirklin. Minn. Med., January, 1928, p. 28.

A clear statement of the present status of cholecystography as practised by the majority of radiologists, is made in this paper. At the Mayo Clinic the oral method of dye administration is followed, using plain gelatin capsules immediately after the evening meal, which must be free from fats. The factors necessary for diagnosis are: (1) absorption of the drug; (2) excretion of the drug by the liver; (3) patency of the cystic duct; (4) a resistance mechanism at the valve causing the gall bladder to fill, and (5) ability of the gall bladder to concentrate the dye.

The most frequent and reliable sign of disease is the failure of the gall bladder to cast a shadow in any of the serial roentgenograms; this evidence was confirmed in 95.4 per cent of the cases at operation. Such a finding indicates one or more of the following: (1) occlusion of the cystic duct; (2) contracted gall bladder, with obliterated lumen; (3) impaired hepatic secretion of the drug; (4) inability of the gall bladder to concentrate; (5) injury to the mechanism of discharge; (6) congenital absence of the gall bladder, or (7) failure of the drug to be absorbed. In the last instance the drug can be detected in the bowel. The next most reliable sign is persistent faintness of the shadow. Differentiating between normal and abnormal concentration is more uncertain. Of the cases in which a positive diagnosis of gall-bladder disease was made, 93 per cent were confirmed at operation. On the other hand, of the cases showing normal response, only 69 per cent were found normal at operation, demonstrating that in a test for functional ability, such as this is, we may still have normal function with definite pathology present.

W. WARNER WATKINS, M.D.

The Diagnosis of a Limp, with Special Reference to the Hip Joint. H. A. T. Fairbank. The Lancet, Jan. 7, 1928, No. 5445, p. 19.

The author classifies limps as (1) the short leg limp; (2) the painful limp; (3) the stiff limp; (4) the weak leg limp; (5) the hysterical or functional limp.

The causes of each type of limp are mentioned and their diagnosis and treatment discussed. Special stress is laid on hip affections in children and a differential diagnosis outlined.

M. J. GEYMAN, M.D.

The Dependence of the Energy Distribution in the Depth of the Water Phantom from the Type of X-ray Apparatus. D. N. Nasledow and T. M. Kacura. Strahlentherapie, 1927, XXVII, 169.

The authors have made measurements of the distribution of roentgen-ray energy in a water phantom, using the Siemens Dosimeter. Four different types of apparatus were employed. It appeared that no considerable difference in the depth dose percentage, particularly within the range of short wave length as used in deep therapy, could be detected.

E. A. POHLE, M.D.

WANTED—Radiologist with medical training for 100 bed general hospital, preferably one who could also assume supervision over pathological laboratory, but this is not essential. Beginning salary, $3,000 a year with maintenance. Address A-35, care RADIOLOGY.

RADIUM FOR SALE—50 milligrams of radium offered for sale at a bargain price. Address A-36, care RADIOLOGY.

YOUNG LADY desires position under first class Radiologist at reduced salary to learn X-ray work. Can subordinate laboratory work if necessary. Address A-37, care RADIOLOGY.

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